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1871

Staten Island Improvement Commission.

REPORT

OF A

PRELIMINARY SCHEME

OF



IMPROVEMENTS.



PRESENTED, JANUARY 12TH, 1871.

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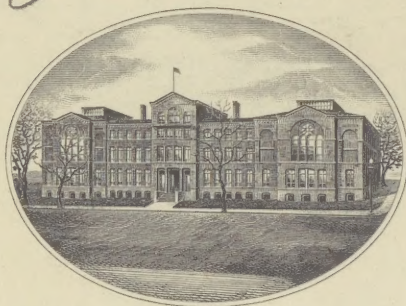


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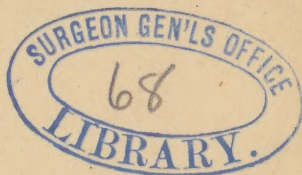
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REPORT.

CHAPTER I.

QUESTIONS OF GENERAL POLICY.

To the Staten Island Improvement Commission :

GENTLEMEN: We need, first of all, to so far forecast the future market of this metropolis for real estate, that we can be satisfied what of its demands Staten Island in particular may be prepared to supply with the greatest certainty of large, general, ultimate profit.

All possible demands of the future may, in the first place, be broadly divided under the heads of Commercial and Domestic; domestic being understood in this case to refer not only to dwellings but to whatever would administer directly to household economy, convenience and comfort, including stores, shops and markets, for local supply.

The eastern margin of the Island, from a little north of Tompkins landing nearly to the Yacht Club House, has advantages of a peculiar character for certain commercial purposes, deep water and good holding ground being found close off shore, and large shipping being less liable to be troubled by ice than at any other point in the harbor at which it can lie with equal safety and convenience in other respects. An extensive use of these advantages would lead to the building of a special class of warehouses, factories and shops along the shore. As, within narrow limits, this demand is liable to become an imperative one, the erection of many permanent and costly domestic buildings on this shore is not to be expected. The sooner, therefore, its commercial advantages are developed the better.

Beyond this district, we do not think that a commercial demand for

real estate is ever likely to be of much importance, or that it should be courted, for the Island, and as we are advised that a different opinion is held by some of your Commission, we wish to explain why.

In any region where the value of land depends chiefly on its agricultural productiveness, as, a generation since was the case here, any undertakings that are calculated to improve its means of communication with a distant market, or to establish a market within it, can hardly fail to benefit the landowners, who, consequently, are often asked to aid in the introduction of them. Nearly all of the territory of the United States being in that condition, there is naturally a pretty strong public opinion about the interest and duty of landowners in this respect. But Staten Island is now very differently situated from the country in general. It has no difficulty in finding a market for its crops, or in finding shipping enough to move them. What advantages, then, can it expect to gain by courting commerce?

In answer we may be pointed to the value which real estate has acquired in the commercial quarter of New York Island. Staten Island has a much greater extent of shore on the same harbor than New York Island, and while it is considerably nearer the sea, it is also approachable to better advantage from the main land, especially by railways. Does it then seem unreasonable to expect that by adding certain artificial to its natural advantages, so much of the commerce of New York can be drawn to Staten Island, as will greatly advance the value of its real estate?

The question is how much—how many acres—of the whole area of the island is likely ever to be actually occupied, do what you will, for commercial purposes? We think we can show that it is very little indeed.

If we look at the two parts of New York city as divided, say, at Fourteenth street, we shall see that one side is mainly occupied for commercial purposes, the other for domestic. Imagine, then, that this division had been made more perfect, and that it had not been confined to the politically limited New York city, but had included all of that larger New York, now numbering a population of nearly a million outside the city, which sends a deputation of men every day to its commercial quarter. Under this division it will be evident that the buildings of the domestic class not only already cover a great deal more ground, but that *their number and area of occupation is enlarging much more rapidly* than that of the commercial class, and this notwithstanding, perhaps, that the amount of business transacted, of goods exchanged, is larger than ever before.

It is not very difficult to see some reasons why this should be so, and why it is likely to continue.

In the progress of commerce, men of marked ability have more and more duties pressed upon them, and duties in undertakings of the most diverse character. The necessity of personal conference in regard to affairs requiring separate offices, gives increasing value to time during certain hours, and distance is for these purposes yet equivalent in the market to time. Hence vicinity to various offices becomes an increasing element of value.

The increasing specialization in business which often makes many sources of supply necessary to be called on for a purpose which could formerly be served by one, tends in the same general direction ; the result being always an increasing motive to compactness.

At every center of commerce, consequently, more and more business tends to come under each roof, and, in the progress of building, walls are carried higher and higher, and deeper and deeper, so that now "vertical railways" are coming in vogue.

It may be thought that these observations apply only to commerce in a restricted sense, that is to say to exchanges and administration, and especially not to manufactures and shipping. The question is important because some think that it may be possible to establish a great manufacturing quarter of the metropolis on the island, and with this in view a different line of policy might be advised from that which we shall assume to be required. It is well known that conditions which make a difference of many years in the expectations of life with operatives are no obstacle of consequence to the success of manufactories. Let us then examine the facts.

There are between four and five thousand manufacturing establishments on New York Island, with an aggregate capital of about \$70,000,000. Why are they on New York Island rather than anywhere else ?

Not because of cheap land, cheap building materials, cheap food and lodging for operatives ; not because of cheap coal, or wood, or water-power, or taxes or insurances. For all manufacturing purposes in which these conditions are of primary importance, building sites must be sought far away, not only from New York but from Staten Island.

It is true that for certain of the latter class of purposes cheapness of transportation to and from the island of New York becomes also important. But the cost of transportation lies chiefly in the loading and unloading. Distance, within certain limits, extending far beyond Staten Island, counts but little. Moreover such disadvantages as distance establishes are lessened by every extension or improvement or

addition to the roads, boats, telegraphs and mail facilities which connect the outer country with the town. They will be less in the future than they are at present. Thus the difficulty of establishing new centers or new sub-centers of manufacturing, like Newark, has, of late years, greatly increased and will continue to increase.

Dividing then, all manufacturing purposes for which land and buildings are liable to be required, into two classes, one of which economy will place at a comparatively remote distance, we see that, with respect to the other class, the same motives operate as with reference to buildings simply for the exchange and administrative offices of commerce—motives, namely, which favor a tendency to increasing compactness of association; to higher and deeper buildings, and to the occupation of less and less land relatively to the whole amount of the trade of the port.

The increasing use of large, deep, fast steamers, lying but a few days at the wharf, and each carrying in a year to and from any given hundred yards of shore ten times the burden of the old fashioned coasting craft, and the increasing employment of steam and machinery in handling and stowing cargoes, tends to make dock room of less and less value relatively to the whole amount of freighting business to be done at the port. General McClellan's plans will aid this tendency.

The length of shore front on navigable water within ten miles of the City Hall is about eighty miles, of which a tenth part only, and that all more than seven miles away, is on Staten Island; of the seventy miles perhaps twenty is now in constant demand for the accommodation of shipping; of the remaining fifty an important part, as yet unavailable for shipping, will soon be improved by undertakings in which the cities of New York and Brooklyn and leading railway corporations are now engaged. The land lying immediately back from the shore, to the extent of several thousand acres, is flat and easily adapted to manufacturing and other ordinary commercial purposes. It is on the other hand generally unattractive, and cannot easily be made, even tolerably, suitable for domestic purposes. We submit that at any rate of progress which past experience gives us reason to anticipate, and especially in view of the shrinking tendency in respect to ground-space which we have shown to exist, it will be a great many years before any considerable part of the land thus available and thus likely to be pressed on the market, will be required to be occupied by buildings, docks, or other structures for commercial purposes.

If not, then it is certainly impracticable, by any use of the taxable and other political resources of the county, to place Staten Island so

successfully in competition for supplying the limited amount of land that is going to be wanted in the extension of the commerce of the port that any important favorable general effect upon the value of its real estate can be expected to be produced.

On the other hand, it is only necessary to go out on Long Island a little north and east from Brooklyn to see how harmful an effect is liable to result from a very moderate effort in that direction, many people of wealth who formerly lived there, having been driven away, and tracts of land formerly clothed with beauty laid waste almost as by an invading army, this being the result of a number of scattered manufactories. It is true that there are manufactures which would not be likely to have any such effect, but it is also true that manufacturing establishments started for one object are liable, after a time, to be adapted to another, and that those which have the greatest permanency in the outskirts of large towns are such as are most offensive, and destructive of value to the better class of domestic property near them. Illustrations of this are not wanting on Staten Island. It is also to be considered that it is very difficult to draw the line between a manufactory which is legally permissible, and one which is legally a nuisance, and that when capital has been once largely invested in any works, it is always a difficult and expensive undertaking for the public to remove or control them. The owners of property in the district we have referred to on Long Island, having first invited the introduction of manufactories, have of late years made great but vain exertions to cause the removal or suppression of many of them.

Turning now to the domestic division, is there, in the first place, any question that a tendency prevails precisely opposite to that which we have seen to be governing the commercial—a dispersing and colonizing tendency? If it is recollected that the people who inhabit the tenement-house districts of New York are very little to be taken into account, simply because they are just those who are least able to get what they want, and consequently manifest least what is generally wanted, for domestic purposes, we think there can be none.

A man who has probably made more money by suburban real estate improvements than any one else in the country, said to us lately, "I find that everywhere there has been the largest advance where the streets have been widest and the lots deepest, and if, where the determination of the width of streets and the depth and breadth of lots has been under my control during the last thirty years, I had, in every case, insisted on having them doubled, I should have been at least a million dollars the better for it. I will never again, if I can help it,

have a street laid through or beside property of mine in the outer part of a town, less than a hundred feet wide, nor lay off lots less than fifty feet wide and a hundred and fifty feet deep, unless it is where I wish to draw commercial business or a poor class of people for a special purpose, as where hands are needed for a factory."

Is this experience and opinion exceptional? If so, why, over so large an extent of ground on New York Island, in Westchester and in Kings and Queens has the plan upon which land was laid out twenty thirty and forty years ago been discarded?

This plan was generally that of rectangular blocks of 25x100 feet lots, with streets of from fifty to seventy feet in width, a plan tolerably well adapted to purely commercial requirements. The new plans are less regular and will give larger blocks, wider streets, deeper lots and more open spaces. This, according to our reading of it, is simply an adjustment of the market to a rising demand of a special character for domestic purposes, which can be met on New York Island only by a compromise with the commercial demand, and consequently, at the best, but imperfectly, but which, with the small exception we have referred to, the whole of Staten Island may be adapted to supply in the most complete way and with great and speedy profit to its land-owners.

From an examination of the recent census returns, which we have been permitted to make at the Marshal's office, it is ascertained that in one district, over twenty square miles in extent, about as far north from Wall street as the middle of Staten Island, there has been an increase of population during five years of over ninety-five per cent.; in another sixteen miles distant, a little larger, forty-four per cent.; in another twenty-five miles distant, or further than the most distant point of Staten Island, fifty-five per cent. These are all in Westchester County; and, from personal examination, we know that the larger part of the immigration has consisted of thrifty families, each carrying with it considerable capital, and almost invariably going into villas and cottages, with more or less extensive grounds.

There are a number of districts on Long Island and New Jersey where an increase of a similar character has occurred quite as large.*

* The increase in population on Staten Island in five years has been less than sixteen per cent. The average capital per head brought in and made available for taxation has been less than it has in some of the districts above referred to, which have increased much more rapidly. There are several districts in Westchester and Long Island, as near and as accessible as the most favored of these, which, as we perceive by the census returns, have either lost or failed to increase at all in population, and the real estate of which is believed to have fallen in value. We have either visited or had communication with physicians and intelligent citizens in each of these, and, in every case, the first reason given for the depression of their real estate is a reputation for unhealthfulness.

The suburban travel (chiefly commutation), on five railways from which we have returns, has, during the last ten years, more than doubled the number of passengers, increasing from four to nine millions: on other routes the rate of increase is believed to have been still greater. On several of the suburban boat lines the travel has more than doubled in four years.

The out of town families, some member or members of each of which habitually visit the island of New York daily, now number fully three quarters of a million, and within two years will exceed the resident population of the city. What part of this number is strictly suburban, that is to say, resident in detached dwellings with sylvan surroundings yet supplied with a considerable share of urban convenience, it is not possible to ascertain, but it is certain that the proportion of this class is very rapidly enlarging.

Land held in farms fifteen to twenty years ago, since broken up into plots of from one to five acres, in the midst of attractive scenery, having a fair general reputation for healthfulness, approached by tolerable roads, and accessible in from half an hour to an hour from Wall Street, has almost invariably advanced in value at least five hundred per cent, and often a thousand.*

The tendency, thus indicated, is not peculiar to New York; it now prevails in every other large town, in London and Paris, as well as in Boston, Philadelphia, and in our Western cities. Everywhere townspeople have been lately tending to break town bounds. It may, to be sure, be regarded as a mere fashion, which, acting first on the richer and more luxurious classes, and sending them for the summer only to country seats, then taken up in a little different form by a large number of people of more moderate wealth, has at length fairly laid hold of the masses, in which case it must be expected to soon run out, and be followed by a reaction. But if it is a mere fashion, and has this liability, it is at least singular that it should for years, while sufficiently manifest, have been less powerful, and made its way more slowly at the Head Quarters of Fashion than generally elsewhere.

Regarding it not as a fashion but as a sensible and permanent common movement, the reason why it has been more subdued at Paris is not difficult to see. Obviously it is because at Paris the old theory of a town has been till now essentially maintained, which made it a fortress, enclosed it by walls, and necessarily surrounded the walls by a waste of land, in which domestic considerations were required to yield to military.

If we look closely at any large city, it is to be observed that this

* This statement is made on the authority of Mr. Homer Morgan.

outward current is by no means setting all in one direction, nor does it benefit all points alike in any direction. Some districts are constantly avoided or fallen upon only by the thriftless, and for evident considerations of necessity rather than choice; others are passed clean over, so that sometimes land at a distance is more in demand than that lying between it and the point of departure. We shall hold not only that the general flow, but that all these leapings and turnings of the stream, wherever it has any strength and persistency, are the result of perfectly comprehensible laws, the working of which has been manifest in other forms for centuries. To agree on what class of improvements Staten Island requires in order to derive from it the greatest benefit, there must first be a common understanding of these laws. To carry out such agreement there must be a common faith in them, and in what they will, if heeded, ultimately accomplish. We shall briefly indicate, therefore, the general line of evidence which leads to the convictions in this respect which will govern our recommendations.

A century ago much of the filth which at present is taken off by sewers in most of our large towns was thrown out into the street, under the windows, in front even of the most noble mansions of the richest of cities, and often remained there for months polluting the air, and unquestionably greatly shortening the average period of life of their inmates. Less than a hundred years earlier, the dining rooms of the best houses in the healthiest city of England were at frequent intervals laid over with a wash of soot and small beer to hide the dirt which was allowed to remain upon them. Still another hundred years back we find the dining rooms of rich men's mansions strewn with rushes in order to absorb and partly cover the still greater amount of filth which was customarily permitted to accumulate on them, table-forks having then been but recently introduced, and such offal as bones, cartilage and apple-cores being often dropped from the fingers upon the floor.

We find from evidence, the character of which these facts illustrate that there is a fixed tendency among civilized men, to place more and more value upon the cleanliness and purity of the condition of their domestic life, and a little consideration will show that this law is not confined in its operation to the interior of dwellings, but extends to all that may surround or be associated with them.

Now it is impossible to have a high degree of cleanliness without great inconvenience and cost in connection with many conditions of commerce. Much that would be offensive in and about a dwelling house must be endured in and about a factory, a wharf, or even an office frequented by men engaged in many of the duties of commerce.

Hence, in looking even but a little way back, we see how rapidly, since town walls have become generally less important, the tendency has been developed to separate domestic from commercial life. Late in the last century the largest bankers and merchants of London, Amsterdam and Paris, still maintained their domestic and commercial establishments under the same roof, and the Stewarts and Tiffanies of the day had a door opening between their show rooms and their family dining-rooms.

The constantly increasing distinctness of separation between the commercial division, and the compact domestic division, in all large modern towns, is one result of this law of progress; another is the gutters, gratings, sewers and water-works by which a large share of the filth which was formerly endured in and about the house is rapidly taken to a distance, and which have made it possible even to move about within the town without coming in direct contact with anything very obviously dirty. These improvements have been so great, and their results so beneficial, that the average length of life of the classes of the people who live the year through in the city of London has been doubled. But it has not yet been found practicable to keep the air of compactly-built parts of towns pure and sweet, and lives are yet shortened and made painful by the privation. It is doubtful if it will ever be possible to overcome the difficulty of doing so in localities of a certain density of population where the two great natural agents of disinfection, sunshine and foliage, cannot act largely and freely throughout the streets, and on each side of every house. In fact, beyond a certain point, density of residence is incompatible with a high degree of cleanliness or a high degree of health, comfort and civilization. The difficulty is vastly increased if to the thronging of mankind is added the liability of dust, dirt and unwholesome emanations of various manufactories.† Here then is one reason why our great cities will never be able to retain within narrow limits the families of those who are engaged in their exchanges and manufactures. They will be able to do so less and less. By modifying their plans, making larger blocks, wider streets and more numerous and broader public places and parks, they may bring the necessary evils of compact building within certain bounds, but the process must go much further than it has yet done, even in Paris, where, in fifteen years, \$375,000,000 was spent in this

† In nearly all large commercial towns in Europe great undertakings have been planned, and in some carried out, for securing more space in and about the dwellings of that part of their population which, by its avocations and its poverty, is practically precluded from moving into suburbs. Liverpool has recently expended over \$5,000,000, and Glasgow has asked authority from Parliament to make a loan of \$7,000,000, to be expended in the course of twenty years, for this purpose.

way, or in London where \$24,000,000 has just been spent on sewers alone, before the migration to a considerable distance from the commercial districts, of the classes most advanced in civilization, will cease to grow constantly larger.

There is one other motive element in this movement to which it is necessary to allude—the esthetic. There is no doubt that with the advance of civilization there is in the mental constitution of civilized men an increasing susceptibility to certain forms of beauty, especially to the beauty of nature, apart—so far as it is possible to regard it as ever apart—from associations of health and comfort. In what degree this element guides the suburban movement it is hard to say, but that it is of some consequence and increasing consequence, is proved by the extent to which it is abused in the course of catch-penny speculations. Nothing has been more common of late than to recommend building sites on account of the natural beauty of distant prospect which they possess, or the local attractiveness of the land itself which is offered for sale, when the process of building and of so called improvements in the neighborhood will assuredly destroy both. It may seem hardly necessary to say that views of woods which will soon be felled, streams which will be turned into sewers, meadows that will be built on, landscapes that may be shut off, are of no permanent value in a home, but it is certain that they are accepted as such in thousands of cases, and that they enter largely into the fictitious valuation of real estate which causes so much distrust and confusion in regard to permanent conditions of value.

There are few things which make greatly for the happiness of men concerning which they know so little of the process by which the happiness comes, and the conditions on which it depends, this as of the beauty of nature. It is the commonest experience that men destroy beauty under an idea that they are going to increase it.

But most men will, at first sight, prefer a coarse colored lithograph which is dear at a dollar to a Claude or a Murillo, which has, nevertheless, during hundreds of years been regarded as a treasure, and for which there are to-day not a few men who would gladly give many thousands of dollars. And it is probable that there are not a great many who, having the painting placed where they would see it, without any effort to force admiration, several times a day for some years, would not learn also to place something like the true market value upon it. Undoubtedly it is the same with the beauty of natural landscape, and the beauty of parks and gardens. Men do not know on what their enjoyment of one locality more than

another depends, but they find that one permanently contents them more than another. And upon the degree of general contentment which can be assured to any community, will the value of the real estate of that community in the long run wholly depend.

In dealing with a question like this, of the most economical means of *permanent* improvement for a large area near a great center of business, nothing is more important than a realization of the utter folly of a policy which has heretofore been often followed with profit by individual speculators in a small way. To illustrate the danger of it we shall refer directly to local experiences.

Within the memory of several of your members, and since the childhood of most, the value of nearly all the land on Staten Island was established by reference solely to its advantages for fishing and agriculture. One-third of the appraisement of what were then the most valuable farms was due to the fishing rights which were sold with them. The demand for dwelling-sites by men engaged in business in New York began between 1830 and 1840. The probability of its increasing soon occurred to many persons, and upon this farms began to be bought and held idle "on speculation," along the East and North shore.

We propose to briefly and, of course, imperfectly, trace the history of a single district of from a thousand to fifteen hundred acres in extent, which, in the judgment of many, was at that time the most attractive of any on the island, or even perhaps of any on this side of the Atlantic. The land had been held for generations by the descendants of the original settlers. Their interests being divided between fishing and agriculture, but little of the ground was kept under the plough, most of it was in wood or broad greenswards. Old trees had an unusual value, ship builders from New York being wont to run down the bay, and select timber for special purposes in the woods, buying it standing. Hickories of a certain size and form were also in request for the fisheries. The woods were thus managed in a way not very common with farmers, a certain class of trees only being picked out and felled for ordinary purposes, and those promising special profit allowed to remain and spread broadly; the groves were therefore notable for their beauty, and something of this may be seen in portions of them yet remaining.

The owners of the land lived in quaint and cozy, low-roofed and broad-galleried cottages, approached by the most delightful class of summer roads, winding among the great trees, crossing clear brooks

and skirting the smooth clean meadows. A man might search the world to find an alternative to the commercial town more complete or more pleasing. It was believed also by the best physicians of New York to be a place of distinguished healthfulness, and there is yet no reason to doubt that it was so. The apparent objections to it were merely the difficulties of access, the badness of the roads in the Winter and Spring, and the want of society.

The land traders, when their time came, promised to remedy these objections; a wharf was to be built, and direct steam communication established with New York, roads were to be constructed and each of the farms was to be divided into a number of places adapted to country-seats and villa sites, inviting to a good class of residents. This was chiefly undertaken by an association and so far as it was able to obtain possession of land it at once laid out a broad straight highway through it, crossing the shallow valleys upon low causeways. A wharf was also subsequently built, and direct steamboat communication for a short time maintained with the city. No substantial improvements in the way of drainage were made, however, nor was the slightest thought given, apparently, to securing to the public in the future any claim upon the preservation of the various elements of health and beauty which now gave the land really the better part of its value.

The expectations of profit of those who engaged in these enterprises were to a considerable extent realized. Numerous places were sold, houses built and grounds laid out. To the original reputation of the district for the beauty of its landscapes and its detailed and local rural charms was added a renown for the attractions of its villas, gardens and society. All choice sites rapidly advanced several fold in value.

Another class of changes began to be noticeable between 1845 and 1855. Such improvements as we have described had drawn not only a considerable number of families of great and moderate wealth, but also many with little or no accumulated means, who were employed as laborers and servants. The steam ferry made the island generally known to holiday excursionists. A lager beer garden was established to aid the ferry enterprise. The ground least saleable for villa residences began to be occupied by shops and small dwellings, stables and vegetable gardens, to make room for which fine trees were often felled. Several of the original suburban places became nearly enclosed by those of the later formation, and thus less valuable for their original purpose.

At length two or three factories were established in the neighborhood, increasing the demand for small lots for lodging houses, stores.

and dram shops, thus still further lessening the attractiveness and the value of a certain part of the territory for suburban purposes. The means of livelihood of some of the later arrivals being precarious, when hard pressed they helped themselves to fuel, which they found first in the old farm rail fences, and then in the unenclosed woods which remained. Large tracts of these, consequently, were cleared soon afterwards by their owners. The construction of roads across the valleys had in several cases arrested the natural flow of water upon the surface, and some of the old water courses not only lost all their beauty, but, from the mingling of household wastes with the water made stagnant by obstructions, became disgusting and dangerous. Some places presently began to be known as unhealthy. All soon came under suspicion.

An intelligent stranger could now no longer possibly reach the parts which retained any of the original conditions of attraction, to look at a site offered him for a residence, without having the question raised:

"Suppose I come here, what grounds of confidence can I have that I shall not by-and-by find a dram-shop on my right, or a beer-garden on my left, or a factory chimney or warehouse cutting off this view of the water? Is this charming road sure not to be turned also into a common town street, strewn with garbage, and in place of these 'velvety woods, can I be certain that here also there will not soon be a field of stumps with shanties and goats and heaps of cinders? If so what is likely to be the future average value of land in this vicinity? Whatever advantages it still possesses over other districts about New York as a rural or suburban dwelling-place, it never can possess any for compact building at all superior to a hundred thousand acres elsewhere about the city. Looking either with reference to enjoyment of it as a place of residence, or as an investment for my children, I must be cautious not to be too much affected by superficial appearances. *What improvements have you here that tend to insure permanent healthfulness and permanent rural beauty?*"

We know that in certain cases, this course of reflection and inquiry has operated to prevent the sale of places, and we also know that since the conditions to which we have referred have been very distinctly manifest, the rent and market value of a large number has declined or at least ceased to advance, while at the same time, the number of people going out of town in search of places of residence has vastly increased.

There is another district on the island which, within twenty years, has been made accessible from the city in half the time that it was

previously, taking contingencies into account and with reference to practical connection with the commercial center. It was believed, and confidently predicted by able business men that the completion of the railway, by which, mainly, this has been accomplished, would double its real-estate value. We find that, in fact, it is doubtful whether the gold value of land in this district has advanced at all. We know of several cases in which land has been recently bought at a price considerably less than that at which it was sold fifteen or twenty years ago.

Surely, it will be said, this is a very extraordinary case—a suburban district of great beauty, declining in value of real estate apparently because of being brought nearer to town, and this, at a period when in other directions suburban real-estate has been advancing five and ten fold in value! But it is not at all extraordinary that a suburban district loses attractiveness when the interests of its landowners are turned from agriculture to idle speculations. In this case obstructions to drainage have been permitted to occur and accumulate, common highways have been neglected, and hundreds of acres of beautiful woodland have been cut away, leaving bare, unsightly wastes in their place to mortify the eye, and making pestiferous swamps of low lands, the superabundant moisture of which was formerly sucked up and harmlessly evaporated by the foliage. The district is much less healthy, and the pleasure with which a family, having any feeling for natural beauty, can reside in it is not nearly as great as it was twenty years ago. Consequently it is less adapted to the market, and, of course, is all the time tending to fall, instead of rising in value.

We could easily enforce our argument by reference to several localities in various parts of the island, giving, if it were proper to do so, names and figures. We could point to one short piece of road laid out and “improved” in the usual way of land traders, in the midst of a district which had previously been flourishing, and by which a series of attractive, small villa sites was opened up and placed in the market. The local outlook was interesting. A pretty stream which ran near by skirted by a nice grove, was regarded as an advantage, as properly managed it certainly would have been. Access to broad distant land and water views was direct, short and convenient. More than twenty houses have been built on this road, the grove being cut away to make room for them. As population has come in malaria and other sanitary evils have been developed. The original builders have nearly all sold out and moved away. A real estate agent having charge of some of the houses tells us that for several years past there has been increasing difficulty in finding good tenants for them and rents have been largely re-

duced. The physicians inform us that this year, not one household upon this road has escaped a visit from diseases which are caused by poisoned air. In the densest wards of New York or London, there has been no larger per centage of preventable disease, and in none have diseases been found to fix themselves more firmly upon the system, and to offer stronger resistance to remedies.

Looking to see what had been the more indirect effect in the neighborhood we ascertained that a house which, during a long series of years, had been a favorite summer boarding-house—frequently rejecting for want of room more applicants than it was able to accommodate, had this year not been half filled. A large villa was pointed out to us, standing on an eminence overlooking the row of houses we have spoken of. It had been sold by its original owner fifteen years ago at a certain price, since considerably improved, sold again last spring at one half the same price, had been unoccupied during the Summer except by a man hired to live in it, and is now offered at a reduction from the price paid for it last Spring.

We do not wish that our remarks should imply censure. However desirable and profitable it may be, where capital can be commanded, there is no obligation upon the owners of land to prepare it suitably for the residence of a community before putting it in the market, and very few, any where, are ever found disposed to do so. As long as the houses in any district stand well apart, with an abundance of trees about them, and only the more healthy situations are occupied, the dangers which threaten a closer neighborhood do not generally very distinctly appear. They may at least be guarded against by individual care. If, however, easy access from the city and low prices for land tempt immigration, with denser population the healthfulness of any locality is liable to become questionable; once established, from year to year the doubt increases; with its increase the prospect of any considerable future advance in the value of land diminishes. The owners at one time elated, become discouraged; they distrust the market value of radical improvements, and are more than ever unwilling to undertake them privately. At length, before they know it, a state of things is reached in which it becomes questionable whether any general combination, supposing it could be brought about, to secure them would effect a sufficient change in the reputation of the neighborhood to make it profitable.

It may be best to inquire here how far this doubt applies at this moment to Staten Island as a whole.

There are parts of the Island which now suffer from an undeserved reputation for unhealthfulness. There are various localities, further

from the city, less attractive in landscape, and less healthy, which stand much higher in the real estate market. There are other places upon the Island, the reputation of which is locally worse, but concerning which we are obliged to say, after examining the physicians who practice in them, and after personal inquiries from house to house, that the worst has not been told. But whatever the shortcoming of public rumor toward them in particular, it is more than made up by the reputation which is fastening upon the Island in general. This growing bad reputation, damaging to the value of every acre upon it, we have found to be greater at a distance, and among people who had never seen it, than anywhere else. It is surprising how far it has already gone. It has been manifested in the most exaggerated form by new-comers from Europe and California. We have more than once seen it expressed in letters of travelers published in distant parts of the country.

Such a one in passing the healthiest part of the Island, including a locality of considerable breadth in which we find no evidence that a single case of malarial disease of local origin has ever been known, is led to exclaim, "What a Paradise!" whereupon his companions are represented as saying "Yes, if you don't find a Paradise on Staten Island it will not be because fever and ague will not do its best to help you," and the writer adds "It is quite true that this Island is as unhealthy as it is beautiful."

How is this to be arrested? How can it be prevented from going on from bad to worse? Never by voluntary individual exertions, never by local action, never by proceedings of one or two of the towns, for as long as a single locality remains in a state to justify it, it is impossible to prevent the undeserved reputation from being applied to the Island as a whole by the general public. And *if* it goes on, according to all experience, the consequences may, at no distant day, be absolutely disastrous. Nothing is more sorry than the fate of any district, which, lying near a great town, gets a bad character strongly fastened upon it. Capital avoids it in all forms except those in which its coming is resisted by all localities in which the hope of better things has not been abandoned. There is unquestionably a tendency to let things drift in this direction among some of the land-owners on Staten Island.

We may as well here as anywhere, perhaps, state our conviction that some of the local undertakings now in progress, which are expected to relieve real estate from the bad name which has been found to be growing upon it, are liable to result in still further disappointment, not only for the reason which has been given—namely the impossibility of inducing the general public, from which any considerable

improvement of demand must come, to discriminate between good and bad localities upon the island—but also on account of the superficial character of these works, and the great expense and difficulty which will be found, if any attempt is made, to keep them in efficacious condition. This is so marked in some cases, that we are satisfied that the evil sought to be removed, will, in fact, be aggravated by them.

But let us ask what are the grounds of hope that Staten Island shall yet make head against this danger?

Harlem, ten years ago, had a place in public esteem much lower than Staten Island has yet reached. Its malarious condition was a constant subject of newspaper banter. Since then a very extensive and costly system of drainage has been carried out, and there is no more joking about Harlem flats. The old reputation seems already quite forgotten; and recent sales are reported at eight thousand dollars a lot for land which, ten years ago, before drainage and street improvements, was held and was unsaleable at five hundred.

The report, of your Committee on Organization, incidentally states that at New Brighton the value of real estate is higher, and has advanced more steadily during a series of years than at any other point on the Island. What is the reason of it? A large part of New Brighton is a remarkably well drained, and in all respects healthy district. It not only commands a magnificent view, but owing to the slope of the surface, it has been impossible to wholly cut off that view from any point. No part of it is compactly built upon. The houses are generally unobtrusive and inoffensive, wholly untownlike, and are surrounded by grounds with a variety of flourishing trees. Its roads are lighted, its wheelways macadamized, its gutters paved, its walks flagged and their slopes and borders neatly sodded.

If the reason is not to be found chiefly in these circumstances we think it will be difficult to account for the low market value of some other land which we have seen—land which, with good roads, could be reached as soon from New York as that midway between Brighton and Tompkins landing; land which is equally elevated, which commands equally fine distant views, which with drainage would be equally healthy, but in the foreground of which there is a pond hole and a raw bank and a gully, which fronts on a road of steep grade, always toilsome to climb and in the Spring liable to be almost impassable, and which is without gutters or side-walks or gas. Land of this description can be bought at a quarter of the price asked for that with which we compare it at Brighton.

The hope of Staten Island lies in the certain large profits of the substantial improvement of its low-priced lands.

But we have been met by men of large experience with the remark: "Staten Island is on the wrong side of the town. Fashion always goes one way and in New York it sets to the North, just as in London it sets to the West."

It is perfectly true that the Eastern outskirts of London are inhabited almost solely by very poor people, that the town extends in that direction very slowly, and that the progress of building in the finer class of residences has constantly been to the Westward, but why? If fashion, what established the fashion? Simply the fact that the town began to grow on account of its commerce, that it stood at the head of ship navigation on the river, that East of the uppermost anchorage, the banks of the river were low and flat and the outlook dreary, while to the West the ground was high and dry, and there were most attractive landscapes.

So far as town houses are concerned the drift of fashion to the Westward has thus been simply a matter of necessity; beyond that there is no drift to the Westward. Ten miles out of town to the Eastward there is as much of fashion and wealth as there is at the same distance in the opposite direction. The villas are as numerous and as fine. The noble seats of Sir Culling Eardly Eardley, Lord Say and Seal, and the Duchess of Sutherland are examples of them—and there are thousands of fine places in the same general direction nearer than that to the town. Whoever has looked upon the country which was near to the South and East, from the terrace of the Crystal Palace at Sydenham, before the view of it was lost behind the host of suburban houses that have been lately built in that direction, will remember that here is a fine elevated, healthy, well-wooded district and that it is studded with villas, country seats and parks.

It is the same at Paris—the best quarter of the town is in the North, in the South are factories and factory people. But go *ten miles* to the Southward and you find the banks of the Marne entirely occupied by villas and suburban villages, to which the Parisians who have no country seats resort for furnished apartments during the Summer. It is a beautifully wooded, healthy, and most attractive suburban district and fashion has nothing to say against it.

Is it fashion that prevents people from selecting Staten Island as a residence? We have known three cases this year in which families of wealth and high social standing, have, after looking at Staten Island, gone past it and found residences to the southward in Monmouth County, New Jersey. One of these had just abandoned a fine place at

Newport, on account of the inconvenience of going there and returning. They went to a place south of and much more inconvenient than Staten Island, simply because of the advice of their physician, that it was more healthy.

We have, during this inquiry for your Commission, visited several of the more successful suburbs—suburbs in which real estate has advanced, and is advancing very much more rapidly than at any point on Staten Island. At none of these are there natural conditions as valuable, in some respects, as at various points on Staten Island; but on the whole we find reason to believe that the chances of securing health and happiness to a family in the long run are but little overrated in the market value of land.

We say but little, because there seems to be some reason to suspect that the long course of make-shifts to which the public has been subjected by men “making haste to be rich” on small capital, has at last had the natural effect of giving excessive market value to land, where the artificial requirements of a good suburban neighborhood are well provided for in a permanent way.

Evidence of this is not limited to the vicinity of New York Bay. Let us look to a point where sheer speculation has run wilder, and paper streets and paper towns have, for a time, been worth more than probably anywhere else for an equal period in the world. Recently two suburban speculations were started near Chicago, one at a distance of six, the other of nine miles from the town, each centering upon a station of the same railway, on land worth, at the time, from one to two hundred dollars an acre. The managers of one laid out their plan in the usual way, made streets of the prairie soil, with neat open ditches, and spaces for side-walks beside them; planted trees, hit upon a good name, got up their lithographs and advertised. The managers of the other borrowed a large sum of money at a high rate of interest, mortgaging not only the land they were to operate on, but other property for the purpose. With this they first underlaid their land with several miles of draining-pipe, then built macadamized roads with paved gutters, iron gratings, concrete side walks, and broad borders, frequently spreading into little greens and commons, planted picturesquely. All the natural wood and the banks of the stream which passed the place, were made public property, and shelters, seats, bathing and boat houses were provided upon it. An Artesian well was sunk, and with a steam-pump water sent to all parts of the property.

Before these improvements were nearly complete the owners began selling land upon the roads at twenty dollars, and soon afterwards advanced their price to thirty dollars, the front foot. The place has just

been lighted with gas, the works being an independent undertaking, and no land can be bought at present on the improved roads at less than forty dollars. It is not two years since the work was begun. Over forty private houses have been already built upon the sites sold, a number of them at a contract price of over twenty thousand dollars. The engineer in charge of the works writes us, as to the effect on the neighborhood, that one tract, which is partially inclosed by the improved territory, and barely touches at a corner upon one of the macadamized roads, and which was valued two years ago at from \$80 to \$100, has been recently sold at \$1,000, an acre. All surrounding property has advanced 200 per cent. during the last year. With regard to the enterprise nearer town, it is a complete failure, it stands to-day as it did a year ago, not the first house having been built upon it.

We turn from this lesson in the West to another of equal significance which comes to us from the opposite quarter. East of the City of London, there are districts to which we have already referred, in which, among dust-heaps, brick and coal yards, and large waste places, there are clusters of habitations which from their wretchedness have been spoken of in Parliament as a national disgrace. Efforts have sometimes been made to relieve the dampness, which is the primary cause of the abandonment of these districts by every thing which is wholesome and decent; but, until recently, they had always been of a superficial penny-wise, pound-foolish character, resulting in disappointment. One such was alluded to by Mr. Dickens, in a description from which we draw, with slight contraction of the original, the following account:

"In such a neighborhood stands Jacob's Island, surrounded by a muddy ditch, known in these days as "Folly Ditch." A stranger looking from one of the wooden bridges thrown across it will see crazy wooden galleries common to the backs of half a dozen houses with holes from which to look upon the slime beneath; windows broken and patched; rooms so small, so filthy, so confined, that the air would seem too tainted even for the dirt and squalor which they shelter; wooden chambers thrusting themselves out above the mud, and threatening to fall into it—as some have done; dirt-besmeared walls and decaying foundations, every repulsive lineament of poverty, every loathsome indication of filth, rot and garbage; all these ornament the banks of 'Folly Ditch.'"

Six years ago it was determined by the authorities that one of the worst of these wretched eastern parishes should be, as far as the streets and public property were concerned, thoroughly improved. Matters were so bad that plans had previously been discussed for a whole-

sale deportation of the inhabitants. What actually was done included the construction of a sufficient number of deep under-ground drains, falling into a main, which extended to a distance, the road ways were macadamized, and tar concrete walks laid by the side of them, water was laid on, and gas lights provided for. To accomplish this, it was necessary to raise money by loans, payable in fifteen to twenty years. Mr. Fisher, the engineer, employed to superintend these improvements, is now in this country. He informs us that before they were well completed, the old shanties and pestilent rookeries began to be laid low through the voluntary action of the owners of the land, and that in place of them, now, less than six years from the outset of the work, may be seen hundreds of attractive cottages and villas, with neat grounds about them. A healthy and thriving population, able to bear a large taxation has come in, and although no exact statistics can at this moment be furnished us, there is no doubt of a great profit from the undertaking.

In the extended observation of the different members of our Board on both continents, not an instance is known in which similar results have failed to follow works of improvement judiciously adapted to provide good roads and walks, and well drained and healthful building sites, with attractive sylvan surroundings within convenient distance of any large town.

The effect of substantial suburban improvements, even where unnecessary for health, is not at all mysterious. The outgoing townspeople do not reduce their standard of comfort in any respect materially, and they soon become discontented if they go where the degree of study and forethought, and skill in management of household affairs which they are accustomed to use is very greatly augmented. People moving from the country to the town rapidly lay aside habits of careful provision in respect to many details of housekeeping. They keep but small supplies, and wait till they are nearly out before taking thought for their replenishment. It is nothing to call or send to the grocer's or the butcher's or the baker's, when anything which they supply is found to be wanted. But the distance of a quarter of a mile over a bad country road is a much greater difficulty to a housekeeper than three or four miles upon a clean firm flagged street. A well fifty feet deep comes as a severe blow often repeated. Kerosene lamps all over the house and utter darkness outside the door give constant anxiety. Considerations of health being equal, it is the degree in which objections of this class to a residence prevail, here and there, that chiefly determine the direction of the suburban currents.

There is no doubt of an increasing domestic demand for land divided on a larger scale than has hitherto been generally adopted, or than is desirable, where commercial convenience is the primary consideration. A question remains as to the extent of the enlargement demanded?

Of this, the course of reasoning we have followed enables us, perhaps, to form some idea. Houses, for instance, must be so far apart, that the air of each shall be absolutely free from contamination arising from any other or from the highways; the highways must be so far apart, so spacious, so furnished or flanked with trees that organic waste can not be carried from them, to an injurious extent, into the houses between them; that the air passing across them shall be quickly disinfected or screened of whatever it takes up that is filthy. If a highway is short—taking little or no through traffic, requiring a wheel way of not more than 22 feet, the minimum thus reached would but little exceed the space of the ordinary town arrangements, except in the size of lots.

What then, is required to be possessed by each family, for its private use, out of doors, beyond what can commonly be had within towns?

We answer that a high state of health, or a sound moral condition can never be acquired by children or preserved by adults under the requirements of success which modern town life tends to impose, where it can not be made easy and convenient to spend considerable time out of walls—more time than can honestly be spent in idleness or in occupations which, with us, are deemed consistent with publicity. For this purpose there needs to be attached to every house a series of out-of-door apartments, not open to public view, in which direct exposure to sun and wind may, when desired, be avoided, and in which various ordinary household occupations may be carried on. One of these should connect with the kitchen, another with the social rooms of the family; there should be turf on which young children can walk, and fall without injury, on which girls can romp without soiling their dresses; there should be a dry walk for damp weather, a sheltered walk for windy weather, and a sheltered sitting place for conversation, needle work, reading, teaching, and meditation.

We repeat, that with the exciting and engrossing interests of the stage of society which we are now reaching, arrangements such as these are essential to a high state of health in a family. Every physician will endorse this statement. We can dispense with them as our ancestors could dispense with chimneys and table forks, with cotton and silks, with potatoes, sugar, coffee and tea; but it will cost us more to dispense with them than to obtain them, and learn to use them. Sooner or later all civilized people will learn to use them.

These requirements involve no large amount of land; but the minimum can not be much less than twice that of our present ordinary town lot.

How much must be added to this in order to admit of any degree of artistic luxury and completeness will depend very much on situation. With good, shaded highways, walks not liable to be overthronged, it is not at all necessary that the house should command fine distant or general views, it is rather better that stand-points for these should be possessed by each family in common with others, at some little distance from the house, so as to afford inducement and occasion for going more out from it, and for realizing and keeping up acquaintances by the eye at least, with the community. To give children a fair chance to develop their individual tastes and talents, however, without disturbance to neighbors, even with the most wholesome family discipline, the space of private ground must be enlarged, under most circumstances, to at least what would be inclosed in a parallelogram of fifty by one hundred and fifty feet. Where less than this is taken it will soon be from necessities of poverty, not choice.

It is not desirable that the lot should be a parallelogram or of any regular and uniform shape, on the contrary, it will be more satisfactory if it is not. It is much easier to fit a house and grounds agreeably upon a space of land, the sides of which are not parallel and the angles equal than upon one of the ordinary town-lot form.

Can we get any idea of the maximum? Suppose that two, three, or four hundred thousand families are to be in competition for land, each needing to have one member, at least, spend the larger part of each day in close proximity to the center of business; obviously the maximum for each will eventually be fixed chiefly by considerations of the cost of the land, established by competition, within certain limits of distance; and the limits of distance as far as time of passage is concerned will be, up to a certain point, constantly enlarging in every direction.

Yet we do not think that the progress of invention is to tell so much in the improvement of the speed with which distances can be overcome as in the cheapness, frequency, regularity and *comfort* of transportation. The question will be between cost of passage and cost of land; the nearer, other things being equal, the more valuable the land and the less of it must be accepted for what each man can afford to pay. But the measure of cost for passage will not be wholly in the value of time required for it and the fare; the incidental occupation of the time will be an important item. At present there is scarcely a suburb of New York the

time to reach which from Wall Street, is not, on an average, worse than lost, that is to say, so far from being passed profitably, it is passed most expensively—at great cost of nervous energy, health and comfort. An addition of ten per cent. to the cost of running the Staten Island ferry boats, with good roads and walks from the landings, would make it possible for most men to be in the way of gaining health, of receiving enjoyment, of spending their time profitably, doing two-thirds of all that would be given to the necessity of passing from Wall Street to their home.* Nothing like this can, as yet, be asserted of any railway line of exit from the town, and there is no reason to suppose that any form of land communication will ever be invented by which, without vastly larger cost, it will be possible to make the time occupied as valuable as it may be now made in water conveyance.

The greatest improvement will probably occur, however upon common highways, which there is no difficulty in carrying to the point at which one horse can do the work which must be given to three on our present roads. It is not improbable, also, that steam omnibuses will soon come into use, and that these, running from landings and stations, at a speed of ten or twelve miles an hour, will call at all houses on the highroads, whenever required, as the old coaches did. There are, at this moment, no practical difficulties in the way of this method, except those with which any new arrangement of general public utility has to contend. There are already in different parts of the world over four hundred steam carriages working successfully on common roads. But better and generally wider roads are the first requirement.

When there shall be, as there soon will, two or three hundred thousand families to be provided with houses out of town, the least space wanted by each of which shall be what we have named—and when the possibility shall be realized of occupying the best part of an hour's time of transit not uncomfortably, competition will then fix such a price upon all land within an hour's distance of the city, that only men of exceptional wealth, and tastes for rural domestic life, will think it best to pay for the use of more than eight or ten times as much of it as the amount we have named as the minimum for health. The ordinary size of the house lot which will soon be most in demand in the suburbs may thus be approximately estimated. Along the shores, where sites can be reached by a short walk from the steamboat landings, it will probably be from quarter to half an acre. Wherever there is a

* The boats have most uncomfortable seats, are badly ventilated, and at night badly lighted. Being, also, short-handed, or with inadequate organization of service for their duty, passengers suffer from disorder and nuisances which might easily be prevented. These little matters make all the difference between misery and comfort to many, especially many women. The landings and houses are in every way the reverse of attractive and convenient.

tendency to reduce it much below this, men will prefer to spend more time on the passage, go farther and enjoy the use of more space. At a distance from boat landings, a larger area will be generally wanted to compensate for the greater trouble of land conveyance, and men who can afford to keep horses will also be able to afford to buy more land. Sites then will be in demand large enough to admit of some luxury of personal property in local landscape. The maximum, under ordinary circumstances, within an hour of Wall Street, on elevated land, and in a healthy and well furnished neighborhood, is not, in our judgment, likely to permanently exceed five acres. The average for all the more attractive parts of Staten Island, clear to its furthest extremity, beyond distances within an easy walk from the shore, would be less than that, but certainly not less than one acre. If the interior land should be cut up in smaller plots than an acre, most people will prefer to pass a little more time on the public conveyances, and go further. This is to be inferred from the readiness with which thousands are now induced to travel by the most fatiguing and expensive means of conveyance to much greater distances than Tottenville, to gain no advantage except that of controlling a little more land for their money.

If our reasoning has been good, we have thus determined with some approach to definiteness for what form of real estate there is likely to be in the early future the largest demand in the vicinity of New York. To what extent that demand shall go, and how rapidly it shall be developed is a question in all probability of the completeness and rapidity with which a supply shall be provided for it to be fed upon. In any locality where such building sites have been provided as we have described, from a quarter of an acre to five acres in extent, well drained and in all respects healthy; approached quickly, cheaply, and with any tolerable degree of comfort from New York; where good service of tradesmen and public servants may be had, where water and gas may be laid on, where pleasant natural scenery is accessible, and where these characteristics extend over a sufficient breadth of country to give assurance of a suburban domestic neighborhood of a permanent character—in any locality which comes near offering these advantages—the indications of experience all are that if twenty thousand building sites could be put in the market, there would be twenty thousand families glad to buy them at once, at prices a good deal more than double the present average value of all the land on Staten Island—and it is hardly to be doubted that if they did so, there would be one hundred thousand people healthier, happier, richer and better for the bargains. We do not know where one such site can be had near New York to-day at ten times the average value of land on Staten Island.

The result of our study thus far has been to suggest a doubt whether there is any safe intermediate ground between an abandonment of the Island to the condition of an outskirt quarter of the metropolis, which, while it may increase in number of population, will lose in quality—an outskirt which will tend constantly to compare less and less favorably with the more fortunate suburbs—and an undertaking of improvement which will be likely to give it the first rank among them for healthfulness and general convenience, and which will have the result we have described, of causing twenty thousand detached villas and cottages, to be soon built upon it by capital to be brought from without and thus made available for local taxation.

We will go further and say that we have been led far toward the conviction that the position of the Island with reference to the center of business, and its natural attractions, are such, that if it could be relieved of its bad reputation in one single particular, the public would accept temporary inconvenience in other respects, taking the risk of delay in improvement of access, of roads, of water supply, and of other common suburban requirements, and that the Island, relieved from the single disadvantage to which we refer, would rapidly advance to the position of the best suburb, and its real estate command the highest rates of the market.

The one particular to which we refer is of course its unhealthfulness, and its special unhealthfulness depends simply and solely upon malaria. Aside from malarial troubles it has always been the healthiest suburb of New York.

The problem of malaria will be considered in a second letter. Without present argument upon the latter point, therefore, the views of general policy which we now desire to commend to you may be briefly re-stated as follows:

The value placed by the more far-sighted, prudent and prosperous part of the public, first on healthfulness, second on convenience, third on beauty, especially on rural beauty, in choosing their residence is constantly and rapidly increasing. This increase does not depend on fashion but on fixed laws of civilized progress, it is then likely to continue and may be depended upon as permanent.

The territory conveniently accessible from New York which has any prospect of retaining an agreeable rural character, and which is now free from malaria is limited. The rural territory which is likely soon to be retrieved from malaria is still more limited.

If Staten Island can be freed from malaria, it will be a comparatively easy matter to make it the healthiest, and at the same time the most convenient and most beautiful suburb of New York.

As soon as this character can be established for it a practically unlimited demand for its real estate will occur—a demand which will rapidly multiply the value of every acre of land upon it.

CHAPTER II.

MALARIA AND CONDITIONS OF HEALTH.

The danger that great discouragement and depression may result from the adoption of plans for the relief of the Island from malaria, which should eventually prove to have been inadequate, has impressed us with a strong conviction of the importance of investigating the questions involved in this part of our duty as thoroughly as time would admit.

We believe it to be impracticable to secure complete relief from malaria solely by any system of public works. There can be little hope of success therefore, unless a substantial agreement of opinion, among the leading property holders, can be reached in regard to many questions which are involved in the study of the problem.

For this reason we are desirous to present you the results of our enquiries in a form adapted, as far as possible, to set at rest such doubts as we know are commonly entertained by others in regard, more especially, to the extent of ground on the Island in which there is a liability to encounter malaria; as to the degree of harm which is liable to result from encountering it, as to its sources, as to the practicability of obtaining relief from it, and as to the means of doing so.

Fortunately for this purpose, one of our number, Dr. Harris, had several years since undertaken a special inquiry as to certain of the phenomena associated with malarial disease, had enlisted the aid of a number of physicians and others resident in different parts of the Island, and had entered into correspondence with several scientific investigators in different parts of the country and abroad, for the purpose of interchanging the results of observations on the subject. He was therefore, fairly well prepared at the outset to answer the class of inquiries which most interest the public.

Since the appointment of our Board, and more or less accompanied by others of our number, he has visited all parts of the Island anew, observing, it is believed, every acre of its surface, for the purpose of verifying and enlarging the information previously obtained, and for conference with the medical faculty and intelligent citizens generally on the subject. He has also been assisted in his examination by Doctor J. S. Newberry, State Geologist of Ohio, and Professor of Geology in the Columbia College School of Mines, who is not only eminent in his special branch of science, but having practiced medicine

in the malarial regions of the West, and thus been led to give particular attention to the influence of geological conditions upon health, is unquestionably the first authority in the country on certain of the points involved.

After two months of constant searching inquiry, made with these advantages, and with, we are confident, an entirely unbiased, candid, and cautious disposition of mind we feel prepared to report certain conclusions with a reasonable degree of confidence.

We should be glad, were it possible to lay before you full minutes of the evidence which has influenced the judgment that we shall express upon the practical questions to which the problem gives rise, both that obtained from persons direct and from medical and scientific records; but as, on account of its voluminous and frequently minutely technical character, this is out of the question, we have adopted the course of propounding a final series of questions to our medical associate with a view of presenting you, in a comprehensive and wholly intelligible form, answers which shall embody the more significant results of the general study which has been given the subject. Should it be desired, we are prepared to give much more detailed and specific evidence on most of the important points discussed.

The report of questions and answers which follows has been deliberately reviewed and approved, not only by Doctor Harris but by several other medical gentlemen of the island, and the opinions expressed may, we believe, be regarded with confidence as those to which the closest observation and the most cautious and responsible study of the questions presented has led. These remarks apply more especially to matters of medical opinion. For others, all the members of our Board may be considered as equally responsible.

Q. What is Malaria?

A. A poison in the atmosphere of certain localities which is recognized only by its effects, of which ague and fever is an example.

Q. Besides ague and fever what other effects of this poison are observed on Staten Island?

A. Disturbance of sleep and general uneasiness, rheumatic and neuralgic pains, lassitude, and a marked disturbance of the digestive organs and the vital energies, are commonly complained of in the localities where fever and ague prevails. They are mitigated or removed by the same antidotes, and are in most cases unquestionably due also to malaria. The most virulent form of disease produced by malarial

poison upon the island is pernicious congestive fever which, where proper antidotes have not been quickly administered, has sometimes proved fatal. This has occurred in but few neighborhoods and rarely.

Q. In what proportion of the households upon the island, do forms of suffering or discomfort occur which physicians attribute to this poison ?

A. Disregarding certain localities which are in general comparatively safe, amounting altogether to not more than one tenth of its area, it must be said that the population is almost universally affected in some degree by malaria. The effect of it has been sufficiently decided within the last six months in about three-fourths of the households to induce the inmates to consult a physician ; of the fraction referred to as comparatively safe very little can be said to be perfectly secure against malaria wafted, under certain atmospheric conditions, from the other parts.

Q. Are those who have suffered from the more severe forms and persistent influence of malarial disease permanently enfeebled or constitutionally injured thereby, as a general rule ?

A. As an invariable rule.

Q. Are other animals than man affected by malarial poisoning ?

A. Frequently and decidedly, on Staten Island. (See appendix.)

Q. Are young children affected by it ?

A. There have been numerous cases of late on Staten Island, in malarious places, in which infants only a few days old have suffered severely. They have been born with the poison in their system.

Q. Is it probable that malarial poisoning in many cases where it does not very distinctly appear, that is to say, by the ordinary symptoms, acts harmfully by stimulating, complicating and increasing other diseased tendencies ?

A. It certainly does so.

Q. The tendency to drunkenness or to a morbid desire for stimulants for instance ?

A. Yes.

Q. It exerts a general demoralizing and debilitating influence ?

A. Yes.

Q. Does it appear that malaria is increasing on the island—affecting more people and acting over a larger part of the surface ?

A. It does, so far as mere extent of its effects and the frequency of its prevalence are concerned.

Q. And is that the case looking back through a number of years and independently of seasons of an unusual character?

A. It is. In the early part of the present century, and as late as thirty-four or thirty-five years ago, malarial disease was almost unknown, except in occasional years, in localities where it now prevails every year. Dr. Spencer of Westfield, for instance, says that from 1835 to 1839, he did not meet with a single case, and considered the island free from malaria. In 1839 he first began to meet with evidence of its presence. It has now, for a series of years, been very prevalent in the same localities. Dr. Spencer's field of observations extended from Gifford's and Fresh Kills to Ward's Point. Dr. Edgar, the President of the County Medical Society, and the physician of longest experience on the island, states that the "malarial years" occur more frequently since 1845, but that there were occasional intense malarial epidemics in earlier times, as far back as 1827. He believes the malaria now more constant, but usually less intense. Dr. William C. Anderson, whose observations have been very extensive, thinks that the malarial nurseries are more numerous and extensive than formerly.

Q. Setting aside special conditions, such as unusual heat or drought, do the evils of malaria appear to be increasing year by year?

A. Yes.

Q. Are there any instances in which regions at one time free, or nearly so, of malarial poison, have gradually become highly malarious?

A. There are lands which at one time maintained large communities in fair healthfulness, and that have since been almost completely depopulated by the gradual inroads of malaria. This is well known to be the case in parts of the Campagna, near Rome, for instance.

Q. What is known of the causes of malaria?

A. Sir Thomas Watson has, perhaps, given the best statement of the conditions positively known to be most constantly necessary for the production of malaria. He says: "For producing malaria it appears to be requisite that there should be a surface capable of absorbing moisture, and that this surface should be flooded or soaked with water and then dried; the higher the temperature and the quicker this drying process, the more plentiful, the more virulent, the poison that is evolved."

Q. Our attention has been called to a statement cut from a newspaper, as follows:

“ M. P. Bolestra has communicated to the French Academy some observations on ague poison. He says, that in examining marsh water he always finds, in proportion to its degree of putrifaction, a granular microphyte, somewhat resembling in form the *Cactus Peruvianus*. It is always accompanied by a considerable quantity of small spores $\frac{1}{1000}$ of a millimeter in diameter, greenish-yellow and transparent, and also by sporangia or vesicles, containing spores from $\frac{2}{1000}$ to $\frac{3}{3000}$ of a millimeter in diameter, and of very characteristic form. This plant grows on the surface of the water; when young, it is rainbow-like in tints, and looks like spots of oil. At the low temperature of cellars, and in water containing no vegetation, it develops slowly, but in contact with air and exposed to solar rays it grows fast, disengaging small gas bubbles. A few drops of arsenious acid, sulphite of soda, or still better, neutral sulphate of quinine stops its vegetation at the surface of the water: the spores become thin and transparent, and the sporangia alter so they would not be recognised. These changes may be seen under the microscope. M. Bolestra states that these spores can be found in marsh air. He caught ague twice during his researches—once after having been exposed to air from water in fermentation, covered with fresh algæ in full vegetation, mixed with an extraordinary quantity of spores. He thinks these spores constitute the ague poison.”

It is a fact that such oil-like spots are to be frequently seen upon the edge of pools of water near which malarial disease is understood to prevail in the island. What is to be thought of the theory?

A. There are two hypotheses used in accounting for the production of malaria, one is that sustained by the observations which have been read, the other, that malaria is produced directly or indirectly by certain gases or volatile emanations, the nature and combinations of which are yet undetermined, but which are evolved by decaying vegetable matter under the required conditions of temperature and moisture.

Q. In either case the point where danger begins, and the manner in which it spreads would be the same, would they not?

A. Yes, and in this respect we have to deal with malarial diseases precisely as with other fevers. We understand only the physical conditions under which the fever occurs, the factor-like relations of these conditions, the results they produce, and the means by which the local causes can be prevented.

Q. Is it at all improbable that malaria is produced by something

thrown off by a microscopic plant which is liable to be reproduced whenever its seeds are carried by the wind to situations where they may be washed into the midst of dead vegetation, and afterwards find a somewhat warm moisture, such as might on a hot summer's day be produced by the direct rays of the sun on the edge of a marsh or pond, or even under turf, or a bed of rotting leaves, where the soil had lately been water-soaked?

A. While it has, as yet, by no means been proved, such an hypothesis is not improbable. On the contrary, it fits the conditions, under which malaria oftenest arises, better perhaps than any other that has been suggested. Prof. Niemeyer, the most recent of writers on the subject, says it must be so. Dr. Daniel Drake, who spent an active life studying malarial diseases, says, that this hypothesis is better sustained than any other, but is not yet proved. In the latter is the true state of the evidence.

Q. Adopting this hypothesis, what would be the effect of the shade of trees falling upon damp ground with reference to the propagation of the supposed plant?

A. By preventing as great a degree of heat as would otherwise occur, it might hinder its growth and propagation.

Q. What would be the effect of foliage upon the dissemination of the poison?

A. It is probable that the spores or germs would be arrested by and fasten to the foliage. But inasmuch as foliage evolves oxygen and volatile aromatic material, it is believed that the poison is more or less neutralized in passing through foliage. That electrified or active condition which is termed ozone, and which is abundant in the vicinity of flourishing trees, tends to destroy malaria.

Q. What is the effect of foliage on dampness of the soil?

A. No tree can live without drawing moisture from the soil. Experiments have been recently made with great care by Pettenkofer, at Munich, to determine the amount evaporated by a single tree. It is proved that a common spreading tree, such as may grow by the roadside, discharges from its leaves eight and a half times as much water during the Summer, as commonly falls in rain upon the surface of the ground covered by its branches. The tree experimented upon was an oak. More succulent trees, as the elms, maples, and hickories, probably discharge more than that, especially in this climate.

Q. The roots of trees then, wherever they go, act as underdrains to draw water from the soil and discharge it into the atmosphere?

A. Yes, so long as covered with living foliage. Professor Pettenkofer's experiments have proved that during the first three months of summer the activity of this process of evaporation from the foliage is greatest. And those experiments scientifically explain the fact which has long been known, and which can be witnessed upon thousands of acres on Staten Island, that wherever forests are cut away, and brush-wood allowed to remain there will be an increase of stagnant ground-water. Large and flourishing trees when standing fairly separated from each other so as to have ample foliage, as formerly at Clifton, act with amazing certainty and power in preventing the stagnation and increase of ground-water. We see how this occurs, by sucking up at the roots, and throwing off by the leaves—in vapor—eight times as much as the total rainfall on the same area.

Q. And in this way one of the conditions which all investigators are agreed is necessary to the production of malaria, may be prevented from occurring?

A. Yes, adopting the cryptogamous hypothesis, we should say that drainage might cause the death of all the sprouts from seeds deposited on the soil the previous year, as it would those of flags or cat-tails.

Q. Are instances known in which drainage, having been by any means made less effective, districts have thereby been made more subject to malarial disease?

A. Many such instances are known, not only in history like that of the Campagna, but in the records of our civil courts, in the cases which have come up for legal adjudication because of negligence to prevent the occasional overflowing or saturation of lands.

Q. Are instances known in which regions once populous and prosperous have been reduced to absolute desolation and waste by the progress of malarial poisoning?

A. There are many such. Even the Campagna, now a waste and uninhabitable, had at one period, when drained, twenty-three flourishing towns.

Q. Are there instances in which malarial poisoning, once having been common in any region, has been made less common or entirely ceased?

A. Numerous instances.

Q. Has this been the result of the use of artificial means, or of conditions which may be artificially produced?

A. Yes, always.

Q. Can these conditions be generally reduced to these two ; thorough drainage and an increased growth of foliage ?

A. Yes, and as the cases stand, it would be entirely correct to say that such a result has been reached only by deep and thorough drainage. Trees and tillage are adjuvants.

Q. What are the main facts of the evidence to which you referred, supplied by the region about Rome ?

A. The districts soaked by the waters flowing from the Palatine, Aventine and Tarpeian Hills were for centuries excessively malarious. The elder Tarquin carried deep subterranean channels through them by which the stagnant water of the ground was collected and turned into the Tiber. They immediately became healthy and were for a long time occupied by a large population. After the invasion of the Goths the care of the drains was neglected, they gradually became obstructed and so remain to the present day. For hundreds of years these districts have in consequence been made almost uninhabitable by malaria. There is a similar history of other districts about Rome, and within the city itself the records are numerous and complete which show : *first*, the prevalence for centuries of malaria ; *second* the construction of drains, followed by freedom for centuries from malaria ; *third* the destruction or obstruction of the drains followed again for centuries by malaria.

Q. There have been some similar experiences in France, have there not ?

A. Yes, at Bordeaux and Rochefort, and in large districts of the Lorraine.

Q. And in England ?

A. Many in England. In large districts where ague and fever was common twenty or thirty years ago, since the general adoption by the farmers of the system of thorough-drainage for crops, it has quite disappeared. This is true of parts of Essex, Lincolnshire, Cambridgeshire, Kent and Sussex ; also of Stirlingshire and Perthshire in Scotland. There are remarkable instances also in Ireland. Hundreds of cases might be cited, in our own country, in which the disappearance of malarial disease has followed close upon land drainage, several in the western part of the State of New York. Batavia was at one time so malarious that its prosperity was seriously threatened. A public meeting was held at which a physician, Dr. J. B. Cotes, advised the drainage of some water soaked land near the town. The work was commenced by subscription, but had not proceeded far, when the profit of it became so evident that the owners of the land carried it out on their own account. Malarial disease began at once to be less prevalent and

during the last sixteen years the town has been essentially free from it. Shawneetown, on the Wabash, suffered fearfully from malaria until after 1838. In the construction of a railway through it one seventh of all the men engaged died. A ditch, which at one point had to be cut to a depth of forty feet, having been opened through the town it at once became healthy and has since so remained. The terribly malarial effects that attend upon the wet-system of rice culture; and, on the other hand the speedy relief that has followed the substitution of dry-culture, are facts well known.

An illustration of another character is furnished us by Doctor Hertzog, a pupil of Professor Von Pettenkofer, the highest authority in Europe on this subject. The King of Bavaria had two stud-farms, on one of which it was found that the horses were constantly liable to fall into low condition, while on the other, with the same rules of management, they were in excellent health. The best veterinary surgeons were consulted, and many experiments in diet and regimen tried without success. Rough coats, bad digestion, sudden mysterious deaths, and a general low tone continued to prevail. Professor Von Pettenkofer, hearing of the circumstances, obtained leave to examine the subsoil of the locality. He ascertained that though superficially dry, it was a little below the surface completely saturated. He urged that the farm should be thorough-drained with tile laid not less than four feet below the surface. This was done at once, the following year the horses recovered, and there were no further complaints.

In a recent letter to me from Prof. James Law, of the Cornell University, he states that "the various forms of 'anthrax' and the 'brand' or splenic disease, are indigenous among domestic animals pastured on wet and malarial lands. These diseases, and the blackleg and other distressing maladies have disappeared whenever the lands have been thoroughly drained. In Potsdam, Prussia, the domestic animals were formerly decimated by such diseases, but they have disappeared since the lands have been drained. Also at Elahaff, near Douanwerth, where these maladies were formerly rife, they have totally disappeared since the wet lands were drained as Prof. Von Pettenkofer advised."

Q. What is the character of the evidence that connects the occurrence of malarial disease with decaying vegetation?

A. Perhaps the most conclusive is that afforded first at the town of Urbs Vetus in Italy, which from its elevated situation might have been expected to be free from malaria, nevertheless suffered terribly. An eminent physician, Dr. Lancisi, detected the cause of it and secured an

ordinance forbidding the rotting of flax near the town; malaria immediately and permanently disappeared. This experience led to the prevention of flax rotting in ditches in France, Ireland, and other countries, always with the same desired result.

Q. Is there an unusual amount of stagnant water, and water-soaked soil during every period of dry warm weather, in the immediate vicinity of each of the localities distinguished in the medical records of Staten Island for extraordinary malaria?

A. Yes, without exception.

Q. One of the largest of these districts, as you have informed us heretofore, lies near the railway on the South side. We know by personal inspection and otherwise that several hundred acres of woodland (estimated by a resident as over a thousand) have been cleared in that vicinity during the last ten years, much of it low and sedgy land. We are also informed that the construction of the railway caused obstructions to the natural water-courses from some parts of this low land. Must the increase of malaria in this vicinity be attributed wholly to these two circumstances?

A. It is to be attributed mainly to these, but also to the dropping out of cultivation of much land formerly valued and well tilled for farming purposes, but lately held only for speculation, to some extent by non-residents, water consequently finds its way more slowly through the soil; soils that once bore good crops when under the plow now bear sedge-grasses, and retentive subsoils have been formed near the surface, where formerly the plow and spade prevented this mischief. I have witnessed the same evil in certain undrained paper-city lands in Kings, Queens and Westchester counties, where malaria is quite as troublesome as on Staten Island.

Q. Do you consider that the prevalence of malarial disease on the Island is chiefly to be attributed to the difficulty with which rain water finds its way below the surface, to a depth where it will remain too cool to admit of the generation of the malarial poison?

A. That difficulty is a primary condition.

Q. What is there in the soil of Staten Island which makes it difficult for water to soak through it?

A. The drift which covers the greater part of Staten Island as well as the opposite shores of Long Island and parts of New Jersey contains, even where it is apparently most sandy, particles of feldspathic clay, ordinarily in a condition of impalpable fineness, but which were originally deposited in the form of silt. When wet, these parti-

cles expand, and, coming in contact one with another, form a slime or puddle, filling what would otherwise be the waterducts between the larger grains of sand and other particles composing the soil. The dust of the serpentine ridges which form the elevated points of the Island has a similar property. A certain form of iron (hydrous oxide), in a finely pulverized condition is also abundantly diffused in the soils of the Island; where this is washed in with the argillaceous, feldspathic or serpentine debris, it forms with it a kind of cement, impenetrable by water.

Q. The elements of this cement are in the first place washed together by rain water, but when thus properly commingled have the property of resisting its passage?

A. Yes.

Q. Does this occur upon the surface?

A. Sometimes; there are remarkable instances near the iron mines at Centreville, for instance, where rushes may be seen growing on the crowns of hills, but it is not general except where a considerable body of water is often collected by depressions of the surface, and where it evaporates slowly?

Q. Why not generally upon the surface?

A. The form of iron which has been referred to, is changed by the action of oxygen, and another form is taken which is pulverulent, and through which water passes freely. The air penetrates soil near the surface when it is not covered by water, especially when it is under tillage, and oxygen is thus transfused through it to a certain depth. Going down six or eight inches the indurated form of iron may often be found in scales, more often as a dark stain in a plate or hard-pan of sand, gravel and clay, which it firmly holds together. The soil below this pan may often be found dry when that above it is mirey. I have, during the past dry Autumn, seen in various cuttings of earth-banks, an upper or second stratum yielding a constant stream of water of super-saturation, running off from a thin impervious "hard pan," while the gravel or the sand immediately beneath, and for several feet in depth, not only was not saturated, but was loose and dry. In digging drains or wells the pan is often broken through by the pick, and thrown out in pieces which appear as hard as if they had been broken out of an old water-cemented cistern wall. They will bear a sharp rap with a walking stick without fracture. Place one of these upon a plate in a dry airy room and after a day or

two it will have quite disappeared. In its place will be a little heap of loose grey and reddish loam.

Q. In the western part of the Island there are extensive tracts of sandy surface, apparently very open, yet we hear complaints of malaria upon them. What is the difficulty in those cases?

A. They are frequently underlaid with the same hard-pan. The most deadly malaria is often found under such circumstances. That is the condition of the celebrated malarial plains of Walcheren in Holland.

Q. With the liability to the formation, a few inches below the surface, of a water-cement by the process which has been described, how can under drains act to relieve the surface of water? Why would there not soon be a water-holding pan above them?

A. It is a well proved fact that the earth immediately in contact with the drains, if not naturally porous, soon becomes so; if they are laid in clay the withdrawal of the water which would escape by the open joints of the drain will cause the clay to shrink and open in many fine fissures, as may often be seen in a clay bank by the road side. These fissures as soon as the water has ceased to run through them will be filled with air. Gradually, after several rains perhaps, they will extend until they have reached the water-holding pan and penetrate it; giving the air opportunity to reach and decompose the cement from below. They would behave precisely like the masses of hard-pan laid up to dry, falling into masses of powder.

Q. And tillage facilitates a similar action in dry weather from above?

A. Yes.

Q. Pools of water from twenty to fifty or a hundred yards in width are common upon the Island. Are they generally liable during droughts in the hot season to become "stagnant" in the common acceptance of the term, that is, productive of cryptogams, and of malarial poison?

A. There are upwards of a thousand such pond-holes upon the Island, and excepting in excessively wet and cloudy summers they inevitably produce vast quantities of algæ and other chryptogamous plants which are continually reproducing and decaying, and the more rapidly as the quantity of water decreases by evaporation. Such places are malarial nurseries for the Island.

Q. And, contrary to the usual belief, they are more common on the

higher parts, and in rolling ground with an apparently open sandy surface than on the long and gentle, nearly level slopes?

A. Yes. They are frequent on the ridges, and on several square miles of the western parts of the Island, a space of twenty acres can hardly be found without what is called a pond-hole upon it, that is a basin, the bottom of which is cemented and covered with a vegetable deposit, often several feet in depth, sometimes covered with water and sometimes simply saturated. These are even more frequent, midway between the waters enclosing the Island than near its circumference.

Q. Are the rims of these basins often rocky?

A. Not one has a complete rim of rock in place, and only a very few of them have any rock near them. They could in most cases be drained of water by a pipe laid five or six feet from the surface of the rim of the ground about them. In this respect the Island is more fortunate than any other district of equal extent, no further removed from the city. To relieve some portions of our suburban districts upon Long Island, Westchester and Queens Counties, and New Jersey, from malaria, deep excavation and works of far more formidable character and cost will be required. Unfortunate as the reputation of Staten Island is for malaria, the sources of it can be more speedily and completely removed than those in other suburban districts.

Q. We were told by citizens of Northfield that in the low flat district between New Springville, Graniteville and Morning-Star Road, over which the waters of the Willow Brook are spread, that deep drainage would be impracticable on account of a natural dam of rock. What are the facts in that case?

A. There is an impervious ridge of trap rock thickly overlaid by diluvial gravel, extending from the shore near Port Richmond to Long Neck, between which and the upland, east of Springville, there is an extensive basin which receives, from Willow Brook and other sources, some two million gallons of water a day, which, in some cases covers large surfaces, making marshes; in others, saturates the soil just below the surface. In dry weather much of this water stagnates and breeds malaria, and the whole district, together with its borders is at night, or whenever the sun is obscured, very chilly. There is in this quarter, consequently, a special liability to pulmonary complaints (as well as to malarial), which are comparatively rare in the greater part of the Island. For this, as well other reasons, it is very desirable that the region in question should be relieved of its excessive dampness. There are two methods of operating for this purpose. The inflowing streams should be controlled and deflected from it, and it should be drained.

Professor Newberry assisted me in a careful examination of the supposed obstacles, and is of the opinion that there is nothing in the way of the perfect drainage of the whole area to any depth desirable for sanitary or agricultural purposes. It only requires a little care in engineering the course and grade of the outlets. Most of the land but for its dampness is very fertile, and by drainage would be rendered available for highly salubrious residences, and profitable culture. Much of it is now worse than useless, as the emanations from it unfavorably affect the health of an important part of the town of Northfield and the reputation of the whole Island.

Q. Are there any basins on the higher parts of the Island formed by ridges of the serpentine rocks?

A. None such are found which are due to the rock. The serpentine ledges will not, like trap or granite, hold water. On the contrary, the serpentine and talcose rocks as they are found on this Island, are very remarkably absorptive rocks. (See Statements of Experiments in Appendix.)

Q. All the class of rocks which are commonly referred to on Staten Island as serpentine have also the property of changing temperature much more slowly than most rocks have they not?

A. Yes. They are peculiarly non-radiating. That is, the serpentine rocks when of the varieties we see on this island, namely, the soft steatite, dolomite, talc and magnesia, transmit heat very slowly, but retain it tenaciously.

Q. Is it for this reason they are valued for the beds of ovens and in the form of soap-stone are formed into stoves and foot-warmers? That is to say because, although they heat up more slowly, they retain heat and yield it as a gentle warmth for a very much longer time than iron or any ordinary hard building stone?

A. That is the reason.

Q. These qualities pertain to the whole of the elevated masses of serpentine which we find on Staten Island?

A. Yes, and this ridge of soap-stone and porous magnesian rock extends from New Brighton Point to St. Andrew's Church and the Fresh Kills at Richmond village.

Q. These masses are, in effect, two ridges of rocks, which are projected boldly to a height of from two to nearly four hundred feet above tide level, and together are nearly seven miles in length, surrounded by a low sloping base of drift and alluvium, and at a distance of a mile or

two by tidal water; must they not on account of their singularly absorptive and singularly non-radiating qualities have considerable influence upon the local climate.

A. There are facts which indicate a certain degree of influence highly favorable to health from them, but, they are complicated by the phenomena produced by the superficial conditions which have been described, and which would be removed by thorough-drainage. We are warranted in stating that if these rocky ridges were of granite or trap, and exposed as they would be, they would vastly increase some of the conditions which now render some of the uplands unhealthful. *The* rocks we actually have on this Island are highly favorable to this natural requirements for healthfulness. They are even more favorable than chalk cliffs or sandstone would be in the situation.

Q. How do they affect the local climate?

A. Their effect, if not contracted by the superficial conditions referred to, must be at all times a moderating one. By absorbing moisture, they would tend in cold damp periods to limit the reduction of temperature at the surface of the ground, by exhaling moisture, they would equally tend to restrain the elevation of temperature in hot dry periods. Radiating heat more slowly than other rocks, or than ordinary soils and substrata of soils they would tend to give unusual length to the process of a general change of temperature. They would for instance, part with less heat late in the day or early at night than is usually given off from the Earth's surface, and *more* late at night, when the temperature of the air is coolest—thus moderating the common chilliness of the latter part of the night. When this chilliness is extreme delicate persons are often most unfavorably affected by it. They would tend to prolong the Autumn and to make the changes of Spring less sudden, extreme and trying.

Q. You say they would do so. Are such effects observable at all as a matter of fact?

A. They are, distinctly—have been often remarked by observing men, and the advantages thus sometimes gained by delicate persons in certain parts of the Island are recognized by the older physicians upon it. They would be much more marked were it not for the hard-pan crust which so generally is found in the soil, and which has precisely the opposite qualities.

Q. Which opposite qualities may be completely changed by thorough drainage?

A. Yes, not may be only—they have been already to a certain extent in several places.

Q. South of this are there anywhere on the coast masses of rock found having strikingly absorptive or non-radiating qualities?

A. In Florida, the coral reefs.

Q. Any to the North?

A. Nowhere on the coast.

Q. Is there not a somewhat similar quality in the rock which forms the mass of the Isle of Wight, and does it not aid to give it its special reputation for healthfulness?

A. Yes, but the elevated parts of the Isle of Wight, as well as other health resorts in chalk cliff regions, are barren wastes in comparison with the Staten Island hills, and less healthful than Staten Island could be made.

Q. Do you know what the effect of that reputation for salubrity in the Isle of Wight has been?

A. It has brought families of the most intelligent and refined classes and many wealthy persons to build and permanently reside upon that island; large numbers of such residents have gone thither from all portions of Great Britain and various other countries, and thus a great value has been given to the land which would otherwise have remained almost worthless.

Q. Below one of the principal ranges of hills (sometimes called Grimes Hill, formerly and more properly "Signal Hill") in which serpentine rock and iron ore both appear in large masses, there is a broad stretch of flattish land upon which the passage of water flowing from the hills is evidently slow and often obstructed. The character of the herbage and the moss on the trees also indicate a saturated soil. According to our hypothesis this district (the Clove Valley, Concord flats and Rocky Hollow) should be a seed bed of malaria. How do medical records bear out the suggestion?

A. The facts are that at some points, where the evidence of an arrested flow of water and of water-soaked soil over considerable areas is most obvious, malarial disease not only prevails but fever of a pernicious type, has occurred more than once during the past five years. There are records of its occurrence, in the same localities, going back to 1827. The amount of malarial disease, of the common types, has been increasing, however, as woods have been felled, and the surface of cleared land has been less cultivated. There are but few households in or near these flatlands which have not suffered from malarial disease of late years. The same is true of most of the flatter surfaces below the hills throughout the Island.

Q. Is the malarial poison generated in these beds liable to be wafted up to and over the high ridges which overlook them?

A. It is. They are nurseries of evil to all more elevated grounds which chance to be so situated as to receive currents of air from them.

Q. Are there any facts going to show that persons resident in houses at a considerable elevation above these seed beds are poisoned by malaria while at their residences?

A. Facts such as this for instance—a physician reports that he has recently visited a lady who for weeks suffered from malarial poisoning; she has scarcely been out from her own elevated grounds, not at all at night, and has lived wholly in the second story of her house, at an elevation of three hundred feet above tide water and two hundred and fifty above the lowest point of the malarious valley upon which her windows open, and from which they are half a mile distant.

Q. There is reported to be about six thousand acres of salt marsh on the shore of the Island, chiefly on the continental side. Is this malarious, and if so, can it be rendered harmless by drainage?

A. The actual salt marsh, that is to say, marsh reached by the tide from the sea, is not more than thirty-five hundred acres in extent, and there is no evidence that this is in the least malarious. The immediate margins of such marshes in fact, are, in some cases, where well drained and cultivated, exceptionally free from malarial diseases. In others such marginal land, once malarial, has been rendered healthy by drainage, the salt marsh remaining undrained. Little streams flow from the upland into most of the salt marshes, the channels of which are generally tortuous and obstructed. The fresh water pools and marshes thus formed above the salt marshes are often highly malarious. Little estuaries at the head of salt inlets such as are found at Factoryville, at Richmond Valley, at the outlet of Taylor's Brook and near Seguin's Point are also apt to be malarious. In all these cases however it is the fresh, and not the salt water, that establishes the condition of malaria. From personal inspection and inquiry, I judge that the quantity of such back water marsh, which is not actually salt, may be estimated at about two thousand acres.

Q. Are ponds of water, which have no visible outflow, sources of malaria, even though the water in them is never exhausted by evaporation?

A. There are a few such ponds on the island, in which there is seldom any appearance of algæ or other vegetable growths. Such ponds, in some parts, are usually quite deep, and they are, to some ex-

tent, supplied by springs. In these there is a constant circulation between the deep cold parts and the surface, so that the water in them seems nowhere to become sufficiently stagnant and warm for the evolution of malaria. But such condition is seldom met with, and ponds can be kept from becoming malarial only by care. If, in an extremely hot period, the water should reach a temperature of sixty or sixty-five degrees Fahrenheit, and much vegetable waste were in and around it, malaria would probably be produced.

Q. Are such ponds unfavorable to health?

A. Provided there were no shallow bays opening upon them the soil of which they soaked, and that their shores did not greatly contract in Summer, leaving long slopes covered with decaying organic matter to putrify in the sun, they would be generally favorable to health. The necessary conditions of healthfulness in ponds, which have a value for their effect in landscapes, could easily be established and maintained artificially, but they seldom are so. What commonly occurs is indicated in the record here exhibited, which gives a series of measurement made upon the margin of a pond at frequent intervals during the Summer. The pond is nearly circular, and on May 15th measured 64 feet in diameter. On June 3d the diameter was 5 feet less, the water having receded 2 feet 6 inches, leaving a border of offensive matter. June 10th the water had receded from original outline 5 feet.

June 17	5 6	Aug.	214	Sept. 2	12
24	5	" 8	12	" 7	12 4
July 3	8	" 11	15	" 14	12 6
" 9	5	" 19	15	" 28	14
" 16	7	" 25	15	" 30	13
" 21	8 6	" 28	12	Oct. 3	12
" 24	12 5			" 7	12 6
				" 15	12 8
				" 18	10

It will be seen that with every shower, and according to the varying degree of sun-heat, the width of the exposed margin varied, but that not till the 18th of October did the water return to the original margin. Conditions more exactly in accordance with those laid down by Sir Thomas Watson, as necessary to the production of malaria could hardly be contrived, and, as before said, there are probably at least a thousand shallow-edged ponds on the Island in which a similar process occurs every Summer. The pond-hole to which the foregoing records relate is situated in Westfield, and the observations were undertaken

simply to ascertain the facts for the information of a sanitary officer in the year 1869.

Q. We have seen many open drains leading from the ponds—many miles of them altogether. In frequent cases they simply reduce the depth of water, not wholly removing it from the surface ; in others they barely take the water off the foul bottom, and in most cases where drains of this class have been made more than one season we have found them obstructed. A landowner who had himself made a great many, and who was extremely dissatisfied with the result stated that nine times out of ten some obstruction began to form within a week after they were made, the causes at the beginning being various, sometimes the work of birds or beasts, sometimes of children, sometimes of sportsmen or ramblers who throw in stepping stones, sometimes the lodging of reeds, brush or leaves, sometimes the caving down of the bank. What is the effect of such drains?

A. In all the instances named, and in by far the larger number of cases, in which open drains have been made on the Island, their effect has been to increase malaria by opening to the sun a larger extent of soil, thinly covered by water, or not all covered but saturated, either at or a little below the surface exposed. Open drains are usually succeeded by increase of malaria for a time immediately succeeding their construction, but such is not the case with good tile drains.

Q. And many of the smaller water-courses, farm ditches and road gutters, gullies and culverts being of the same character, do they have the same effect?

A. Yes. Being easily obstructed they form pools, keeping the soil saturated, under conditions favorable to the collection of decaying vegetation.*

Q. Road side ditches, then, as at present formed, are often a nuisance?

* The following observation taken from the Minutes of Information, laid before Parliament in 1852, with regard to the open water courses in the districts of country surrounding London, apply to all the old brook channels on Staten Island, near which a considerable number of suburban residences have been established.

"When there are no floods the water * * * moves sluggishly over uneven bottoms, or lodges in stagnant pools in these ditches, giving off insalubrious effluvia * * * Many of the ditches are used for the outfalls for the drainage of suburban houses, and with the addition of such house drainage the effluvia becomes at times highly noxious and even fatal. The courses of these open water-courses were marked by excessive ravages of the cholera amongst the population living near them.

With regard to wayside drains of the common form, it was remarked that they were open to similar objections, "namely their unsuitableness to small runs of water; wide bottoms intended to be flat, but so irregularly shaped as to impede effectually the current of all but very large floods of water with considerable flows."

A. Yes.

Q. It is generally believed that the *immediate* effect of drainage is to increase malaria. Is that a necessary result of it?

A. It is not. Unless some special precautions are taken, there is danger that malaria will be increased for a short period if drainage is executed during hot dry weather, none if it is carried on in the Autumn. In any case, the danger can be overcome by applying some cheap disinfectant to the newly exposed soil. This has been proved in the extensive operations of Mr. Orange Judd and Mr. Poppenhusen during the last two years near Flushing.

Q. How extended are the records of observation and experience upon which the views are based which have been expressed regarding the origin of malaria in damp and warm decaying vegetation, and the practicability of its eradication where established, by the means indicated?

A. Observations have been making in several localities of Europe almost constantly for centuries, and as malaria has frequently been very destructive to the strength of armies, and monastic organizations, and has frustrated plans of colonization, the investigation of its causes and the records of observations thereupon are by no means limited to those of medical men. The records of observations fill thousands of pages of our most trustworthy medical and historical literature.

Q. Can the fact be explained that the same conditions which on Staten Island apparently give rise to malaria, fail to do so a short distance to the northward?

A. There are a number of trees and plants which are common on Staten Island, but which are very rare, or not found at all north of it. There are others that ripen reproducing seed here which, while they will grow from seed ripened here, will not themselves produce ripe seed much further North, unless perhaps in an unusually warm dry Summer, such as this has been. Such facts are, perhaps, not more unaccountable than that of the special liability of this immediate vicinity to malaria; difference of climate, which seems slight as defined by the thermometer, is adequate to account for great differences of vegetation, and in respect to malaria. As a matter of fact, malarial disease is not at all rare much to the northward of this, and in those parts commonly exempt from it, it often breaks out when from any unusual circumstance, such as the drawing down of a pond at midsummer, a large surface of rich and saturated soil is exposed to be more than usually heated. Such has been the case near Plymouth on the coast,

and near Northampton in the interior, of Massachusetts. Such is at present the case in localities near some of the tributary ponds of the Croton Aqueduct, where it has been unknown before, but has been induced by an unusual lowering of the pond-water.

Q. Understanding that all marshy places and stagnant pools of water, not salt, are sources of malaria which may be remedied by drainage, would their drainage relieve the Island from malarial disease, or would the poison continue to arise from sources not superficially evident, especially from damp ground, the subsoil of which is a hard pan or of a tenacious character?

A. Malaria is liable to arise from such grounds. The thorough-drainage of all retentive soils can alone insure absolute safety.

Q. By thorough-drainage is meant under drainage, adequate to prevent the soil from remaining saturated with water after rain has ceased to fall?

A. Yes; a soil that remains saturated for a day after rain ceases (except in frost), is not thoroughly and sanitarily drained. Sanitary drainage, like agricultural drainage, requires open-jointed pipes, so laid down as to preclude such saturation.

Q. It is generally understood, in districts where thorough-drainage is general, that a common open-jointed tile, after the cracking process (in the stiff soil), which has been described, will completely free soil from water, except such as is held in the pores of its particles, in a space about ten feet wide for every foot of distance from the surface at which it is laid, estimating approximately for ordinary circumstances. If, then, tile are laid thirty feet apart and three feet deep, or forty feet apart and four feet deep, is it to be expected that the locality so treated will be rendered perfectly safe against malaria of local origin?

A. Yes that may reasonably be expected under all ordinary circumstances.

Q. Would a less thorough drainage be adequate?

A. It should not be possible for the soil to long remain saturated within two feet of the surface near a dwelling. If it is, exhalations, causing disease, will be liable to rise from it. To make sure against this danger, drains must be laid little, if any, less than three feet, below the surface. Where there are or have been ponds with accumulations of vegetable matter in the bottom, the drains should be carried, if practicable, below the vegetable matter, and, at any rate, four to five feet below the top of it, otherwise there will be a liability, from the unusual porosity of the soil, to moist exhalations rising through it.

Q. Where the foundations of a dwelling and the land about it for a certain space have been thoroughly underdrained, and where considerable foliage interposes between such a space and any exterior source of malaria, are the liabilities to malarial disease greatly reduced, and, in general, is there little danger that malarial disease would be contracted by its inmates, except by exposure outside their own ground?

A. Instances of exemption so obtained are not unfrequent, even in the midst of very malarious districts, but they somewhat rarely occur, unless where several adjoining properties are so improved; that is to say, where the land is thorough-drained over a somewhat larger space than an ordinary house lot. Examples are furnished in the four adjoining drained farms of Messrs. Garretson, Underhill, Cortelyou, and Mrs. Banker, near Fresh Kills, and on the estate of Mr. Croke, near Gifford's. Adjoining each of these there has been much malarial disease, but the people living upon them, to the number of seventy, have scarcely had a symptom of it. In another quarter the adjoining places of Messrs. Meyers, Simonson and Luling may be referred to. They were formerly very malarious, and the families living on them before their drainage, since living elsewhere, on the island, continue to suffer from malarial poison, there first contracted. The families which remained upon them after their thorough-drainage, recovered, and have since suffered not at all, and those who have moved to them since their drainage have lived for years upon them without suffering at all from any form of malarial trouble. Beyond the influence of the underdrains, the neighborhood is still highly malarious.

Q. The difficulty of obtaining outlets by which the water collected would be at once removed harmlessly to a distance, is one of the obstacles to efficient private drainage, is it not?

A. No doubt it is. For example, none of the property on the Fingerboard Road, or upon Pennsylvania Avenue, can find outlet for necessary drainage except by artificial channels through other property.

Q. Malarial poison being established in a locality where there is excessive moisture upon the surface, and where decaying vegetable matter, and the liability to a considerable degree of heat from the direct rays of the sun occur together, and these conditions being maintained through a series of years, is there reason to believe that something from the organic waste of a large and increasing population being added to them, malarial poison is increased?

A. Yes; not only so, but to malarial poison others are added which come from domestic wastes, and the compound effects are of a very dangerous character, often causing incurable diseases and fatal epidemics.

Q. Are all persons, of whatever habits, when living, or passing near the places where these poisonous compounds form in the air, liable to suffer from them?

A. They are. Good habits, good houses, and good food can not insure protection against such sources of danger.

Q. And the distance to which they may be wafted, without losing fatal power, can it be strictly limited? May it, under special conditions of the atmosphere, be much extended?

A. Yes. Malaria may be wafted overland and up hill sides some distance. There is ample proof that when favored with a warm and moist atmosphere the malarial poison may be wafted for a mile or more, especially when borne along the course of valleys and hill sides.

Q. We have seen several localities on the east and north shores, where the conditions exist under which these fatal compounds are liable to be generated, have we not?

A. Yes.

Q. Generally they are to be found near the outlets of the island streams, are they not?

A. Yes.

Q. As communities enlarge near these streams, it will be essential to safety that these household wastes should not be discharged into them, will it not?

A. Yes.

Q. And will the planting or preservation of trees on their banks be a reasonable precaution against malaria?

A. It will.

Q. Other things being equal, no trees being planted, no drainage of consequence effected, is malaria likely to increase on this island with an increase of population, and is it thus likely to grow more and more unhealthy?

A. More than liable. If no efficient preventive measures are taken, it is practically sure to do so—practically sure, with any considerable increase of population, to become extremely unhealthy. The exceptions will be found only where there is exceptionally good drainage, natural or artificial.

Q. On the other hand, can we feel wholly confident that the removal or prevention of stagnant water, or of prolonged saturation, in conjunction with a high Summer temperature, in all places where dead

vegetation occurs above or immediately below the surface, would be followed by the relief of the island from malarial disease in all its forms?

A. There can be no reasonable doubt of it.

Q. Would such relief be complete and immediate?

A. Yes; but in very retentive soils drains do not always instantly remove saturation of the surface for reasons already indicated.

Q. If all the small shallow ponds, and all the marshy places in which water stands above the surface, or in which its presence just below the surface is obvious, during the Summer, were drained, so that water could not stand in them, within three feet of the surface, would the island be freed from malaria within a year?

A. The liability to contract malarial disease would at least be reduced in a very important degree within that time. It might take longer to eradicate the poison from the system of those who had previously taken it, and as the soil of the island in most districts may now be supposed to contain the seeds of malaria, which only require favorable circumstances to become sources for the evolution of the poison, it is probable that in all localities where the subsoil is at all impervious, and the surface is apt to remain long saturated, malaria would still be produced to a limited extent. The total amount of the malarial element in the air of the island would perhaps be reduced by the drainage of all places where water is obviously stagnant close beneath or upon the surface, of all rush-bearing land, for example, as well as pond-holes, to one-tenth what it is at present. Almost any person, in ordinary health, would resist what remained, and the number of those who would be affected by it would gradually become less.

Q. Your statement would seem to imply that the resisting power of the system was gradually sapped where a man lives exposed to a high degree of malaria—and supposing the degree of malaria to be reduced, his resisting power gradually increases. Is that the accepted view?

A. It is. Experience indicates that a general, even though not absolutely complete extinction of the common sources of malaria, would have the effect which has been stated. The amount of the malarial disease might be quickly reduced to possibly one-tenth what it now is. A slow and gradual reduction below this would subsequently follow, the rate of reduction being a fluctuating one, varying with the seasons.

Q. That statement, that the resisting powers of a man become less, the more malaria he is exposed to, and that his resisting powers

become greater, the more attenuated the malaria he is exposed to, seems to be at variance with the common notion that a man may become acclimated to malaria. Is that notion not accepted by physicians?

A. What is termed acclimatization, and hardening in malarial regions is attended by such impairment of constitutional health as to be as undesirable as fever and ague itself.

Q. So long as the people of Long Island and New Jersey opposite, neglect drainage, what danger would there be of malaria produced there, drifting to Staten Island and destroying the benefits of drainage upon it?

A. None what ever. Staten Island is wholly responsible for the malaria under which it suffers, and it commands within itself the complete remedy for it; malaria seldom travels far over salt-water, never at all except under the influence of a current of highly-heated air. Numerous cases in proof of this might be cited from the records of our military posts and naval stations. The fact is well established.

Q. Can you refer to instances in which belts of trees have been found to protect localities near them from malarial poison?

A. To many. Augusta, Georgia, may be mentioned as one in which a large community was kept nearly free from malarial diseases for many years, by a surrounding border of forest trees left for that purpose. A portion of these trees having been felled, malarial troubles immediately afflicted many households.*

Q. To what diseases, apart from those attributable to imperfect drainage, if any, is Staten Island subject, more than the adjacent continent, the comparison being especially with parts equally distant from New York?

A. None; pulmonary catarrhs which prevail in certain localities to an unusual degree, are attributable to excessive ground-moisture, and would be relieved by drainage. The same is true of rheumatic and neuralgic affections which prevail in some damp localities.

Q. To what diseases if any less in parts where ground moisture, either from natural or artificial causes, is not excessive?

A. Pulmonary diseases, especially consumption;† all continued fevers, especially typhoid fevers; degenerative diseases, as scrofula and cancer; uterine diseases both of tissue and function.

* The surrounding of houses by trees at a little distance is desirable, but the shading of houses by trees in the midst of malarial districts seems to increase the liability of their inmates to be poisoned.

† This remark is limited to the early stages and the cause of consumption, name'y, the deposit and progress of the tubercles.

Q. Is the Island generally believed by those physicians who have been long resident upon it to possess certain special and peculiar advantages in this respect?

A. It is. Where there is no complication from malaria, the greater part of the Island is unquestionably a sanitarium for persons afflicted by, or having a tendency to any of the several classes of disease which have been named, and still more especially for overtaxed nervous systems, and mentally overworked persons. In all its non-malarial positions, this island is, unquestionably, one of the most healthful places in the world, and the most invigorating of any of the suburbs of New York. There have been an extraordinary number of instances of prolonged vigor and great age among the native Staten Islanders, especially in families who have lived in those parts, while up to this time there has been little or no malaria.

Q. Is the advantage which the Island is reputed to possess in respect to consumption, due at all to the malarial elements of its climate?

A. Not at all. *Malaria has no advantages.* This Island is freest from pulmonary consumption in the dwellings and districts where there is no malaria. There is most suffering from it where there is most malaria. Consumption is known to be particularly associated with wetness of grounds about dwellings.

Q. Would this advantage, in respect to pulmonary complaints, be increased, or lessened, and in what degree by the same means that would relieve the Island of malaria?

A. Greatly increased.

Q. The same means being used, what in general terms might be anticipated of the quality of the air upon the Island, with respect to the counteraction of the effects of the irritating, wasting, and debilitating conditions to which men spending their days in the crowded parts of a large town are specially subject?

A. The air of the Island where not at all malarious, has an effect more decidedly remedial to that class of ailments than any other within easy distance from the city.

Q. Thoroughly drained, would the condition of Staten Island be such that physicians might generally be expected to recommend it as a place to be resorted to on account of its special sanitary advantages?

A. They would undoubtedly do so, and people would come to it from far and wide, as they now do in England to the Channel Islands on account of their climate.

Q. It appears then that simply by thorough-drainage it might be transformed from a region threatened with devastation, to a region offering really unparalleled advantages of residence to large numbers of persons?

A. Unquestionably it might.

Q. Thorough-drainage being accomplished, and trees being generally planted on the road-sides, what might we say are the number of chances in a thousand that malarial diseases would not only entirely disappear from the Island, but that it would become as healthy as the elevated regions of the Continent at some distance from the sea, to which people resort on account of their supposed healthfulness; the granite hills of New England for instance?

A. There is not one chance in a thousand that it would fail to become more healthful than any of them. The drainage being really thorough, reasonable caution being used to prevent common nuisances, and the occupation of the land being such as to favor a considerable growth of foliage and clean cultivation, it is perfectly reasonable to anticipate that no place on the continent would equal Staten Island in healthfulness. There are perhaps a few localities, and but a few, which could be rendered equally healthy by similar means.

CHAPTER III.

PRACTICAL RECOMMENDATIONS.

Our undertaking is to suggest to you a series of propositions, which, if you should see fit to adopt them, will serve to determine, approximately, the place, scope, and general proportions and relations of the more controlling features of a practicable plan for the improvement of Staten Island.

WE start with the conviction which it was the principal object of our first chapter to justify, that the improvements required to secure the greatest possible prosperity to your Island, are such as will present the largest number of sites for dwellings, furnished with urban public conveniences and associated with permanent and generally available advantages of landscape and sylvan beauty, all accessible with regularity and comfort from the business quarter of New York, and all pre-eminently healthful.

In regard to this last condition we have in our second chapter distinguished two groups of facts, a disposition to look at which apart, accounts for the conflicting opinions often expressed in regard to the chances of health upon the island.

These two groups of easily observed sanitary facts—those which exhibit the effects of a subtle and generally weak poison, pervading the air of the larger part of the island, and the field of which is surely extending, and those which indicate special exemption from certain classes of ailments, and which account for numerous instances of remarkably prolonged vigor and longevity, especially in the older stock of islanders, we have connected with two corresponding series of topographical and geological facts.

The central element of one of these groups is that of a great mass of

absorptive non-radiating rock* and of a strong argillaceous and ferruginous soil situated in the midst of a natural air tunnel opening from the humid and equably tempered reservoir of the ocean; the central element of the other is that of the thin metallic, non-absorptive and strongly radiating crust which under a condition of prolonged saturation is formed within your superficial soil.

There are three circumstances attending and resulting from this condition of saturation of the surface which need your distinct recognition.

First, while it has, chiefly because of the topographical changes which have attended the increase of population, the holding of land on speculation and the decline of agriculture, been much more general of late years, it has always been sufficiently so to prevent a realization of the special advantages inherent in the geological structure of the island the proper effects of which, though not wholly lost, have yet remained indistinct, undemonstrable, and, from a commercial point of view valueless. Disclosed and developed their commercial value would be very great.

Second, under certain circumstances, and in combination with other causes, it produces the air poison, concerning which we find that from year to year it is increasing, at the same time that the appreciation of its evils by the more intelligent, thrifty and able portion of the public, and the general prejudice against localities where they are liable to be incurred, is also increasing. Put the two conditions together and they involve ruin to Staten Island, unless its tendency to grow more and more malarious can be reversed. For it may be assumed with perfect confidence that, whatever has been the case heretofore, no man of average intelligence, unless under compulsion of poverty, will, in the early future, move from New York Island, to any suburban district which is commonly reputed to be malarious. It may also be assumed that so long as any part of the island deserves the reputation of being malarious, that reputation will practically attach to all parts.

Third, the condition of a prolonged and high saturation of the soil, is so distributed over the island, the seed-beds in which malaria is chiefly propagated are so scattered, and the poison so pervasive that there is little or no inducement to improvement by individual or local enterprise. Again and again we hear of properties selling at

* A statement of trials made at our suggestion, at the School of Mines, to test the absorbent qualities of the rock, is expected to be received in time to be inserted in the Appendix. A measurement of radiative or heat-holding qualities is making, the result of which will not probably be reached in time for this report, but Prof. Newberry authorizes us to say that it is so far advanced as to justify a general conclusion, and that this sustains our conviction that these qualities are sufficiently distinct and extraordinary to account for special local climatic conditions upon this island.

less than the cost of improvements which have been made on them, solely because those who would dwell in them cannot be assured of exemption from the danger of malaria propagated elsewhere.

To recapitulate; this condition of saturation of the soil locks up a treasure such as no other suburb, and probably, no other community in North America, can possess; it poisons the air and threatens the ruin of the island by prejudicing the public against all parts of it as a residence, and it forbids private enterprise and capital from being employed to overcome these two evils.

Here lies, then, the arch enemy of your island. There are two ways of dealing with him. One is to deny his existence, or to insist that his power for evil is local and restricted, and a matter of limited individual and local concern; to say that there are some truths which it is not best to utter, to curse those who make any public admission of your actual suffering and danger, and generally to play the penny-wise, pound-foolish poltroon.

The other is to look all the facts fairly in the face, study them deliberately and fully, and then devise and steadily pursue whatever course shall be necessary to a success which shall be really worth something. A conviction that the last is the wiser way has given existence to your Commission.

The means by which saturation of the soil may be prevented, to the extent required to lay open the locked-up wealth of the island, are well established. During the last thirty years they have been applied with invariable success upon not less, probably, than a million acres of land. They consist in the laying of a sufficient number of open-jointed pipes, generally from three to four feet below the surface, so connected and graded as to form unbroken descending channels for water; this is *thorough-drainage*. The cost may be estimated at one hundred dollars an acre. Elsewhere the primary object of the operation has not been sanitary benefit but increased agricultural productiveness. The effect is not to make the soil, previously liable to saturation, on an average necessarily dryer, but more porous and permeable, so that it will hold and transmit water, in moderate and desirable quantity, not only downward but upward as well, as a lamp wick does oil. A district of country that has been thorough-drained is less dry during periods of drought than it was before. Its spring is hastened, its autumn prolonged, its winter delayed and shortened; the temperature of the soil at these seasons being elevated from ten to fifteen degrees of Fahrenheit, while in extremely hot, dry weather, the surface must be

cooler than before.* Its productiveness in nearly all ordinary farm crops is increased, never less than sixteen per cent, and not unfrequently more than doubled. In view of these and other agricultural advantages great sums of money have elsewhere been spent by land owners in thorough-drainage. But where agricultural productiveness is so small an element in the value of land as it is generally on Staten Island this inducement will not operate. The motive of personal and family safety and comfort, and of gaining an advanced demand for healthful land would do so, to a certain extent, immediately, but for two reasons, one of which, the danger of wafted malaria, we have named; the other is the frequent difficulty and cost of obtaining good outlets for private drains.

Let these two difficulties be overcome—and we know that many land owners are prepared to begin thorough-draining. Once begun at many points, and its advantages in giving increased value to land made evident, it would soon become frequent, and then rapidly general. Overcome these two difficulties, then, and you may look forward with confidence to a not very distant period when your hidden treasure shall have been unlocked, and Staten Island be known of all men as the healthiest dwelling place of the metropolis, and probably the healthiest in the whole country. Every other desirable improvement will follow, provided only the way to it is not obstructed by ill-considered, time-serving, catch-penny plans of “improvement.”

The overcoming by public means of these two obstacles, which it is certain that private means will not overcome, we hold to present so much the most important problems for your study, that all others beside are insignificant.

Let us face the first.

The principal source of malaria upon the island is to be found in the dishes of the surface where water accumulates in the form of puddles, ponds and swamps. Though by no means the only source, it may be reasonably assumed that if this were overcome, the poison in the air would be so much diluted that it would rarely produce fever and ague, and it would be possible by local thorough-drainage, especially if free-spreading trees should be common, to perfectly guard any private place of an acre or more in extent, and certainly any considerable neighborhood in which the land-owners would combine for the purpose, against wafted malaria. It may also be reasonably assumed that if the more distinct effects of malaria should thus become

* We know of no experiments on this last point, but theoretically it must be so, and we have no doubt that it could be proved by trial with the thermometer. All our other statements as to the effect of drainage rest on abundant, accurately measured experience.

no longer common on any part of the island, a fair general reputation for healthfulness would return to it; that it would at least compare favorably with any other suburb accessible in the same time from Wall Street. Private enterprise might then be depended on to carry forward the work of improvement to the higher ultimate stage which is desired.

All propagating grounds of malaria then, of the character we have indicated, must be abolished and prevented, and this can be accomplished only by their legally enforced under-draining.

To compel private citizens to open a conduit from every dish in the surface of their land all the way to the sea or to a natural safe outlet would be obviously unfair. To undertake directly the under draining by public administration of every such dish would involve an interference with ordinary privileges of property very undesirable. A mixed system, therefore, seems to be essential—a system, that is to say, in which the public shall supply certain advantages now wanting to private undertakings and with the offer of which it shall make compulsory the abatement of every distinct malarial nuisance on private ground.

The public should provide safe and convenient outfalls at the general charge of the whole Island, from the sea up to the point where *direct* benefit to the land-owners would result from the laying of under-drains. Beyond that point it should cause pipes to be carried on to the malarial dishes, either by undertakings of the land-owners personally, or by its own agents, the cost in either case, except for engineering and superintendence, to be a charge upon the land directly benefited.

This having been done, outfalls for thorough-drainage would have been generally provided; where they were wanting they should be supplied; it might then be best, in order to hasten an advance toward the end finally to be attained, to offer a release during a series of years, from a part of the taxation which would otherwise fall upon land which should be thorough-drained.

Although we have spoken of the public outfall drains as of two classes, and as if they might be constructed in two periods, there is no doubt that the localities to be reached in the first stage are so scattered and so frequent throughout the Island, and the incidental advantages of every rod of such drains which may be laid are so great, that economy would require that the process should be continuous one. The only important question that remains then in our present duty regarding them, is as to their form, size, extent and frequency. This we shall take up later in the present report.

We can not pass from the general consideration of this subject, however, without again expressing our deliberate opinion, and offering you our most earnest advice, that, if it is thought necessary to neglect everything else that we shall recommend in order to relieve the island of malaria, everything else should be neglected. Nothing threatens your interests, nothing even now compares in importance as a drawback to your prosperity, with this evil of saturated surfaces. Do not think that we undervalue other means of improvement when we say that ten times the money it would cost to carry out our suggestions in this respect, put into roads and railways and steamboats, would ultimately bring you not nearly as much profit. We doubt, indeed, if this Hydra be not soon manfully dealt with, whether cheap, rapid, frequent communication with New York would be at all a benefit to the island. It would not bring a class of people here in large numbers who would be able and willing to pay an advanced price for land and for improvements. It might bring, and it might tend to make the island a miserable, squalid lodging place for, ignorant, uncircumspect, unthrifty men. In short, blocking the way to all suitable improvements, it might fix a character upon the island such as would destroy all hope of any great advance in the value of its real estate.

Once put the island in the way of some relief from this danger, and the value of other means of improvement can not be too highly estimated; but you cannot build without a foundation, and this must be the foundation of all improvement for Staten Island. We feel that if we cannot convince you of this, all our advice must go for nothing.

At the outset of our inquiry, facts came to our knowledge which impressed us with the conviction that, second only to the problem of malaria—a long way following it, but a long way preceding everything else—would be the problem of providing water for household use in considerable parts of the island.

The difficulties of obtaining wholesome water in sufficient quantity, are here and there already so great, especially on the eastern part of the island, even in favorable seasons, that they are fully overcome only by the more enterprising, intelligent, and well-to-do householders. The water from some wells in constant use near the shore is perceptibly brackish, that from some others is impregnated with salts of magnesia, and has a decided action on the bowels. At some points wells have been sunk to a great depth without reaching springs; there are others, the labor of drawing water from which is so great, on account of their depth,

that it puts a strong check on the consumption of the water they yield, which after all is liable to be turbid. But the worst misfortune is that of the liability to organic impurity of the water used where population is growing somewhat dense; this has, without doubt, already been in some cases a cause of fatal disorders, and it is quite certain that with no great enlargement of population, it would render the whole community of the island especially liable to suffer from dangerous epidemic diseases. (See analysis of water from a well in Edgewater in appendix.)

None of these conditions are general, nor do their consequences, as yet, perhaps, seriously affect your prosperity; but if the island advances as we expect it to do, the localities and the number of people in each affected by them will increase, and some means of radical relief will, before many years, be demanded. The direction from which this is to come should be anticipated by your Commission, and in all your plans a way for it at least carefully left open.

The high and comparatively narrow ridge which forms the larger part of the island, presenting no large interior basins, suggests the impracticability of collecting any considerable supply of fresh water within it, except from wells, which would involve a very costly system of pumping. Nor is there any near point on the main land from which it could be conveniently obtained. It has given us, therefore, great pleasure to find that there are opportunities within the island of collecting a considerable supply of water on the surface of the best possible quality. Before the amount of it can be estimated with any approach to exactness, a careful series of gaugings will need to be made. As favorable an opportunity as the present for this purpose is not likely to occur again for many years, on account of the protracted drought of the last season, and we strongly advise you to provide for it immediately. We are only now able to express the opinion that the sources of supply which we are about to indicate would, under a proper system of conservancy, meet all the requirements for pure, fresh water, of a much larger population than at present occupies all of the island north and east of Richmond.

On the ridge line of the range of hills, the south slope of which merges upon the plain of New Dorp, three prominent knolls are observable. To the middle one, which is that due north of the Moravian Church, and near the old Egbert and Sharrot homesteads, we shall have frequent occasion to refer, and as it stands upon and overlooks the site of the old manor of Governor Dongan, we shall distinguish it as the Dongan knoll. Standing upon it, a valley may be seen, or rather a gentle dell, mainly of pastured fields, but with some beautiful

woodlands, descending to the north-west. The water collected on its slopes forms a series of springs, and half-way down a living stream known as Willow Brook, which, near the bottom, being dammed, drives the works of a little machine shop, beyond which it spreads out, forming the chilly district of Northfield, which has already been described. We shall refer to this as the Manor Dale.

A little to the left is the head of another dale trending to the west, the upper waters of which supply the pretty beech-shaded mill-pond north of Egbertville, and the lower that of Ketchum's Grist Mill. We shall distinguish this as the Mills Dale. The water of both streams can be taken by gravity into the Manor Dale at a point well above the swamp east of Springville, where a dam would form an impounding reservoir for all the water gathered by the two dales. An incidental advantage of such an arrangement would be the arrest of the waters which go to form the chilly district of Northfield, thus making its drainage and reclamation a much easier undertaking.

From a point a few hundred yards to the eastward of the head of the Manor Dale, another gentle depression of the surface may be observed, having a more winding course than the two before described, widening at the distance of half a mile into the west fork of the Little Clove Valley, and finally discharging its waters into the beautiful pool known as Martling's Pond, being the lower of Britton's two Clove Valley ice-ponds. We shall refer to this as the Martling Dale. A large and deep impounding reservoir can be formed to hold the waters which it collects, and those also which flow from the Silver Lake valley, and all the northern and central hillsides of the Clove, by a dam constructed at or near that now existing by Britton's ice house in the Glen, but which could, if desired, be easily made to raise the water twenty feet above the surface of the present pond.

Martling's Pond now supplies a considerable share of the ice consumed upon the island, and the quality of the water is well-known and held in high popular esteem. The present dam having raised it so as to flood a considerable area of bogs and bushes, and as it is surrounded and overhung by trees, the leaves of which have drifted into it, the analysis of its waters by no means indicates the degree of purity which it is easily practicable to secure in them. A similar observation applies to the water taken from above Ketchum's dam. It is evident that all these waters are of high rank, but that the latter is of really remarkable excellence, superior to most of the streams which contribute to the Croton, and fully equal to the best. To the eye it is perfectly clear, limpid and sparkling, and the analysis shows that it is soft and possesses every desirable quality in an extraordinary degree. We regard the fact as one of great value to the island.

We have no doubt that whenever a system of water works for the eastern part of the island is fully studied, the several dales which we have described and named will be relied upon to collect the principal part, if not all, of the water.

Neither have we any doubt that, if no measures are soon taken to secure certain public rights and properties in those dales, the practicability and economy of securing a large supply of water of good quality from them will be seriously impaired. What measures they should be we shall hereafter discuss.

We now turn to the question of public communications.

Our object, at present is, chiefly, to discern why Staten Island in all its parts does not gain, at least as much, from the general suburban movement, as any of the more favored districts, and to contrive means for overcoming what we find to be the more important obstacles. Difficulties of access to its shores from New York do not appear to be properly classed among these. We have had special opportunities for ascertaining the motives which have influenced many suburban residents in their choice of locality, and have used them diligently, but have known of no single instances in which the scale has been turned against the island by advantages of access offered elsewhere. We have heard a great many encomiums on the healthfulness, on the water privileges, on the scenery, and on the local roads of the places preferred, but never observed any enthusiasm in regard to the conveyance from town; on the contrary, we have often heard it referred to with disgust and indignation. It costs a great deal more in watchfulness, in time, in money, in fatigue, in irregularity, vexation and disappointment, in the course of the year, for a man who has business daily in New York, to go to any point on the range of hills between Riverdale and Scarborough, for instance, where during the last ten years or more land has been advancing in market value at the rate of 5 per cent. a month, than to large districts of Staten Island where it is doubtful if it has advanced enough to cover interest, insurances and decay of improvements.

It is not to be denied that the ferry arrangements of Staten Island are singularly bare, rude, unattractive in appearance, and inconvenient compared with what they easily might be; but, looking well ahead, this rather tells to the advantage of the island than otherwise. It is quite impossible by the most lavish use of capital to overcome the limitations of room and of many conditions of comfort to great numbers of

people when they are thronging out of town upon narrow iron lines extending through the town itself (and in this sense Brooklyn and the New Jersey towns are parts of the town). And this is especially the case when the first objects of management in the organizations which control them are the movement of freight and of through passengers. The opportunities of enlargement and of adding increased appliances of comfort are as unlimited on the ferries as they are in a country house. There can never be the most distant approach to what a very little capital and skilled architectural study would accomplish for them in the means of access, for instance, to Mr. Stewart's Garden City speculation on Long Island, or to any of the inland suburbs.

We have, therefore, at present, nothing to do with the matter of external communications, except as it is necessary to anticipate improvements in them which would affect the question of the best way to improve the internal communications of the island.*

We may assume that, as soon as any considerable impulse to general improvement on the island has been established, by means which it is the object of this report to suggest, the more radical defects of the present system of communication with New York will, through force of public opinion, competition or otherwise, be put in the way of remedy.

What are the radical defects—that is to say, the defects seriously prejudicial to the Island, and which cannot be remedied simply by a little more study and capital applied to the appointments, furniture and organization of the boats and ferry-landings? They are, preëminently, the liability to occasional, however rare, irregularity and the risk of accident. The weight of defect in these respects depends almost wholly on the force of conditions likely to throw the boats out of their usual course and time. It may be argued that as it is, irregularity occurs so seldom and is com-

* The reason given us by the managers of the ferries for their being fitted only to meet the barest necessities of passage to and from New York, by those who are compelled to use them or live somewhere else than in Staten Island, is that, at present, their receipts do not so far exceed their running expenses as to justify an investment of capital in appliances of convenience, comfort and attractiveness. It is encouraging, therefore, to learn, as we do by returns made by the companies to the Police Department, that the business of the ferries is increasing a great deal faster than the population of the island, the fares collected on the "Staten Island Ferry" being but 912,500 in 1861, while in 1870 they were 2,500,000. On the North Shore Line the business has exactly doubled in five years. In a few years more, therefore, some essential improvements may be reasonably looked for. It is added, and certainly not without reason, that complaints of the means of travel across the bay do not come with a very good grace when made in behalf of a community the civil service of which provides no better facilities for travel than are generally found on shore on Staten Island. Undoubtedly the boats are centuries ahead of the common roads, many of which illustrate in every particular of location, construction and maintenance the result of exactly reversing all established rules for good roads. Costly expedients are now being introduced in road-mending on the island, which have been elsewhere tried hundreds of times always resulting in disappointment and disgust.

monly so slight, that it is hardly worth considering as an objection to the Island as a dwelling place, and that all risk of personal injury from accidents might be insured against at a premium infinitesimally small. But those upon whom this irregularity and this risk is liable to weigh most are not controlled in their estimates of it by the calculations of actuaries, they are nervous women, with strong affections and ingeniously tormenting imaginations, and before twenty thousand more of them can be established in Staten Island homes, there will be a very strong demand that all possible obstacles to absolute regularity and punctuality in running the boats, and especially all possible apologies for abruptly taking off or suspending the usual trips of the boats, shall be overcome and guarded against.

There has been for twenty years or more a settled conviction among intelligent men in all parts of the island that this would be accomplished by the establishment of a landing and a direct "bee line" ferry at the point of the island nearest to New York. The harbor on this line is less liable to be packed with ice than on any other, and the course being straight, the channel broad all the way, and no strong lateral tide-drifts, as in the East and North rivers, except close at the landings, the elements of difficulty in pilotage are less than in going to the Brooklyn or Jersey shore.

Mr. John C. Thompson, whose practical experience and special attention to questions of ferry management gives a value to his judgment which we cannot claim for our own in this matter, says in answer to our inquiry, that upon this line "the route being short and straight, neither storms, ice nor fogs need cause interruption. The passage can be made [by the present boats] in fifteen to twenty minutes." To run half hourly from the present landings would involve an expenditure, Mr. Thompson supposes, of \$300,000 for new boats, as it would require two extra boats to keep up a line of four with certainty, besides doubling daily running expenses. A single powerful, large boat could be built for less than half that amount and put upon the short line, which would be able under all ordinary circumstances to make the passage from pier to pier in fifteen minutes, and there have been no conditions of weather in twenty years when such a boat could not have comfortably made the passage in less than half an hour. The suggestion does not involve the suspension of the existing ferries, but it offers to the people of all parts of the island the alternative of a line *shorter and surer* than any of the existing lines can be, on which to fall back whenever desirable. Mr. Thompson would advise that the direct boat run from 4, 5, or 6 A. M. according to season, from the island, until 7½ P. M. from the city, and that the boats on the old

routes run as at present, or oftener, till 8 p. m., after which they might cease running, the trips of the direct boat being continued till after midnight at least, leaving the island on the hour and the city on the half hour.

Supplemented, as, of course, it would be by railways on both sides of the island, it appears that the existing facilities of communication with New York can in this way be made essentially better, regarding especially the one point of liability to unexpected detentions, than they could by doubling the number of boats, and the working expenses upon the old lines.

We say that this opportunity has been long seen and canvassed by intelligent property owners in all parts of the island, but, although universally looked upon with favor and hope, it is no more practically agitated now than it was twenty years ago. The reason it makes no progress seems to be, that the existing highway system, if the word 'system' is not a misnomer, has been formed without reference to it. New Brighton Point cannot be made accessible, with any tolerable approach to directness and ease of grade, from distant parts of the Island without a widening and straightening and re-grading of some existing highways, the construction of some new ones, and more or less injury to many established property interests. The difficulty of overcoming these obstacles, seems hitherto to have continually increased faster than the disposition to engage with them.

We now proceed to the discussion of what should be called for, in an improved highway plan for the Island.

We have in our first chapter given our reasons for assuming that it is quite practicable and desirable to make the whole island essentially a city of detached dwellings, with only such shops, stores, factories, and buildings for other purposes, as may, advantageously or inoffensively to the great body of the residents, be associated with them. We shall further assume that each of these dwelling sites needs to be provided with ways of communication as direct and at the same time as agreeable as possible, (1st.) with New York City; (2nd.) with those situations, nearest each, which are most suitable and most likely to be chosen as the sites of churches, schools, and shops; (3rd.) with those parts of the Island which are likely to be most attractive for visits of recreation, whether in pleasure-driving, riding, or walking.

We shall likewise assume as probable the eventual construction of a railway from some point near New York, either Jersey City or Ellis Island, to a point on the North shore of Staten Island.

Also, the construction of a railway from the short ferry landing

westward, which shall cross the Fresh Kills marshes near their narrowest point, and thence be carried in a moderately direct course until it makes a junction, not far from Tottenville, with the present railway on the south side; also, that this latter will be extended to New Brighton.*

There are two classes of sites at present upon the island which have special value for villa dwellings—1st. Those upon the border lowlands, from which, or from the immediate vicinity of which, views over the water are commanded that are not likely to be obstructed in the future by buildings or plantations; 2nd. Those upon eminences in the interior which overlook the low lands, and in or near which there is permanent command of expanded landscapes, including portions of the surrounding waters. Keeping in view the general interest of advancing the reputation for beauty and convenience of the Island as a whole, and of increasing its average real estate taxable valuation, it must be conceded that, other things being equal, those improvements will be of the most value, which, while directly serving the general convenience, shall incidentally give new and special advantages to property of a more secluded character.

It is also to be considered that any thing that is *beautiful* upon the Island, and which is laid open to public view, is of value to the public, and that no dwelling, however remote from it, can wholly fail to be advanced in value, by reason, first, of the right of its occupants to avail themselves of it, and, second, of its general influence in an advertising way for the Island. Public roads, then, which while serving as well as possible their primary purpose, incidentally give pleasing prospects to those passing along them are, on that account especially, of more public value and tend to advance the general reputation of the island and to increase the taxable value of all its real estate. We shall assume this also to be conceded.

Finally, we shall take for granted that a definite plan of improved highways is wanted forthwith, which, while it can be realized at an early day if desirable, may also for the most part be carried out gradually, as the advance in population and wealth of the island shall be found to justify; that it is to be general and comprehensive rather than local or detailed; that it is to block out the entire island with a frame-work of highways, between which private taste and enterprise may be fully exercised without disturbing the economy of the general plan; that the purpose is to guide and facilitate improvement, and, as far as possible, not to hamper or restrict it; and in brief, to fur-

* A suitable place for the railway bridge over the Kills, occurs near York Avenue. Should it be located much to the west of this, we assume that the west side railway would be extended by a branch line to the short ferry landing, and that this, in any case, must be the chief point of concentration of common road traffic with New York.

nish a chart of future progress to which individuals may refer and conform their improvements, with assurance that in pursuing their private designs they are also contributing to a complete and harmonious whole, every step toward which, wherever made, tends to the general advantage and benefit.

Great detail in the plan is to be avoided, because once adopted it is intended to become, to that extent, binding upon the land owners, restricting in a certain degree their liberty of action in respect to their property. If such restraint be carried to an extent beyond the absolute requirements of the general public interest, it will be felt as an invasion of private rights, and possibly engender serious opposition.

In devising, under this series of assumptions, a system of highways for Staten Island, it is almost necessary at the outset to take up the problem *de novo*—that is to say, to regard the island as so much territory, conformed, populated, situated and affiliated as now, with prospects in the near future such as are conceded to it, but as entirely without ways for intercommunication; and then, having devised a plan, comprehensive and complete, as best suited to its present wants and its reasonable future expectations, to proceed to adapt such plan to existing conditions by engrafting it upon them. By such method the present highways will be put to their utmost availability; while the transition from the old system to the new will be effected with less of disturbance and, by consequence, less of expense to individuals in readjusting their communications to the new order, than by radical and sweeping changes.

As some slight classification of roads will need to be used, we must explain why we avoid the terms "avenue" and "boulevard." Avenue, formerly used to designate a straight, level approach between formal plantations, was in an evil day used to designate a town street of unusual breadth and directness, also adapted to be planted with trees. For purposes of misrepresentation in regard to paper towns it was afterwards applied with even less propriety; it has reached the lowest point of degradation and abuse when applied, as it now is, by official sign board on Staten Island to a narrow lane leading to a stable. All association of dignity and wealth which once belonged to the word are lost and it henceforth suggests nothing but clap-trap. The only useful significance of the designation, Boulevard, which is the French for the English word bulwark, and properly applied to streets of extraordinary breadth, formed on the site of the old town bulwarks of Europe, is already similarly destroyed past recovery, it being now applied all around New York to wretched dirt roads fifty feet wide. Instead of these

we shall use the old term "high roads" for such public ways as are likely to be in daily use by large bodies of the general public, and which are designed to form main channels between the different principal quarters of the island.

New York being the focus of the principal travel of the island it becomes a primal necessity that the high-roads take that direction, and reach to points of nearest or at least quickest approach thereto, and that they be sufficient in number and size to provide all parts of the island with the most direct and ample lines of approach to those points. Such a road fixed with regard to present location of population and existing facilities of communication with New York, would be drawn from Tottenville, by the most direct line practicable, to or near Silver Lake, and thence to the two ferry landings at present nearest New York, Tompkins and Brighton.

We find that with little bending from a straight line, the topography of the island admits of the construction of such a road upon easy grades without heavy work to obtain them. The most difficult division would be that between Silver Lake and Tompkins Landing. By a slight deviation from the route of the present road, the grade here can be brought to 1 in 25 without much excavation. On this grade with good construction a horse can trot down or up with a moderate load, with speed and safety. At no other point would the grade need to be as steep as this, and it could, with some quite short exceptions, be kept below 1 in 40.

This road would divide the present town of Westfield into two nearly equal parts, and with a few additional lateral roads, would take the greater part of the common wheel travel of that town to the ferries. Hence we shall speak of it as the Westfield High Road. If well constructed it would lead to a great increase of this travel and by shortening the way to the early markets in town would considerably increase the agricultural value of its land, as we are assured by leading market gardeners of the town. It would pass through and open up a district of Castletown and Middletown now the most secluded on the island, and which is accessible by direct roads from no point on the shore; a district nevertheless possessing great landscape attractions, and much of which would without doubt be at once greatly advanced in value by its construction. It would occupy an axial position with reference to the island as a whole, being at all points nearly equidistant between shores.

It could be made to terminate at the proposed short ferry landing without increasing grades, and we propose that it should be so laid out. As compared with present roads, it would shorten the distance to the

landing from its junction with the old Manor Road half a mile; with the road near Ketchum's Mill, three quarters of a mile; with the Ross-ville Road near Marshland, a mile and a half, and from Tottenville, a mile and a quarter. Its width should nowhere be less than one hundred feet, and as the throng upon it would be constantly enlarging as the ferry was approached, from the middle of the island, east, it should be from 120 to 150 feet wide. Of course we refer to the requirements of the distant future, with regard to which its limits should be established. Within these limits a wheelway of ordinary breadth only would need to be soon constructed. The borders should be graded, and made neat, and utilized at once in the manner we shall hereafter indicate.

The Westfield High-road, as thus proposed, falls, it will be observed, to the northward of the main central ridge, or back bone, of the island. This ridge extends only from the Fresh Kills near Richmond to Stapleton, but while its altitude is melted away in gentle slopes to the northward toward the Sound, permitting in that quarter the greatest freedom in the location of roads, it descends toward the sea on the south, in steep and broken declivities, impracticable for roads for rapid travel. As a route toward New York it will therefore be of no direct value to the residents of the greater part of the extensive and populous district of Southfield lying between the crest and the bay.

It becomes necessary therefore to provide for them another high-road, for which purpose the course of the present Richmond Road would be generally satisfactory. This road was originally laid out 99 feet wide, but as the result of a long series of encroachments is now at many points less than 30. We are advised that the county can compel the restoration of the land appropriated from it to private purposes, and if it should be thought necessary to adopt it as one of the high-roads of a new system, this would be a necessary proceeding. It would involve the removal of a number of buildings, and the destruction of a good deal of property, and, the encroachments having been made for the most part generations ago, would bear hardly on many good citizens. We should rather suggest that the lines of this road be but slightly modified, where especially desirable, and, if practicable, that so much of the land originally appropriated to it as is not required for public convenience, should be formally released to the present owners of the adjoining properties. If your Commission should be disposed to adopt this policy, we would recommend a course nearly parallel with the Richmond Road to be adopted for the Southfield high-road, and at such a distance east and south from it as would make the best division of lands. With efficient drainage ar-

rangements this would admit of greater directness and better grades, and would better accomplish all general public purposes.

Before reaching the broken ground near the Black Horse, this road would fork, one branch leading off to Egbertville and Richmond, the other running nearly parallel with the Amboy Road, as will hereafter be proposed.

The present Philadelphia Turnpike or Long Neck Road would serve as a north branch of the Westfield or central high-road. But, still further to the north, there is a large and already very populous district at too great a distance to make use of it as a route to the short ferry. Another high road is, therefore, required to be laid out on a line between this and the north shore, (to which it would be mainly parallel,) dividing the distance into three parts. The dwellers upon the southern third may be expected to use the Long Neck Road, and a course for the additional or Northfield high-road, which would serve the largest number of house sites to the best advantage, will be not far from the line which would divide the other two-thirds. In approaching New Brighton, however, considerations of grade will demand a curve to the north, and not, far west of Jersey Street, probably, the line should merge in that of the present Terrace Road, at the point which would be chosen for a bridge.

Such a class of improvements as are contemplated in this report, will make Staten Island a resort of pleasure travel from all quarters, and, as the great suburban population west of Newark Bay would find the most convenient route of access to it by way of Elizabethport, and as this also will be a point of connection for visitors from all the West, it will be desirable to lay out the western part of the Northfield high-road with a view to its serving as a general approach road from that direction. Its terminus should, therefore, be fixed with reference to a suitable position for a bridge, if that should be found feasible.

Immediately about the short ferry landing at New Brighton Point, where the travel by the three high-roads would be concentrated, there should be an open space of sufficient extent to admit a large concourse of people, on foot and in carriages, to assemble and wait without the necessity of dangerous or uncomfortable crowding. For this purpose it should have an area of not less than two by four hundred feet.

It is beyond our province to suggest what rights or privileges the county can hold or offer to this proposed ferry line. The improvidence of possessing no rights in respect to means of communication, upon which its future prosperity may be very greatly dependent, in view of the arrogance and unscrupulousness with which the business of public carriers is now often conducted, it is unnecessary to argue.

A road along the shore where none exists has been so long called for and the occasion for it is so generally admitted, that we need not state its advantages. It is most required along the south shore, where some fifteen years ago it was agreed that it should be made, the project having been defeated, as we believe it had been once or twice before, by the determined resistance of one or two land owners who approved the purpose in general, but demanded more consideration for their private convenience at the points where it crossed their property.

As such a road would not, in general, be on a line leading directly toward New York, or to any point of much business on the island, and as it would be the only road from which a near view of the lower bay could be obtained, it would necessarily become a route of pleasure travel as well as a neighborhood road, and the object of presenting the sea to view fully and to the best advantage, should be prominent in determining its route. For this reason, beginning at the end of New York Avenue, Clifton, it should be carried with all convenient directness to the shore, and thence follow as near the beach as economy of construction would admit, so that private buildings and plantations could not be interposed to obstruct the seaward prospect.

After reaching a point on New Dorp Plains, where, owing to the flooding of the ground in Spring tides, it would be necessary to divert it to a considerable distance from the shore, it should be laid out chiefly with regard to neighborhood convenience until the hill district north of the Great Kills is reached; at this point a junction would be formed with the Southfield high-road, after which, as it is impracticable, in going west, to follow the shore on the beach, and would be unadvisable on the bank near the beach, on account of its liability to be encroached upon by the sea, it will be an object to keep sufficiently high to overlook the buildings on the lower slope near the shore. This will establish a road intermediate between the present Amboy road and the beach, and will generally divide property advantageously. From New Dorp westward to Prince's Bay, it would serve as an extension of the Southfield high-road, and be a direct route to the short ferry as well as to all the east side ferry landings, for residents along the shore. From Prince's Bay it would pass near the shore to Ward's Point, thence to Tottenville, thence along the west side to the shore road on the north side.

With respect to the internal plan of this road, we would express our general satisfaction with the suggestions of Mr. Root, with whom it has been a matter of special consideration, and whose views are before the public.

Routes will next be required to and between the high-roads, as well as to the railway stations and ferry landings, their general direction being transverse to that of the high-roads, though it will be better that they shall, as far as practicable, approach the high-roads in the direction toward New York; speed with carriages in that direction being everywhere more of an object than in any other, and as the time thus gained in driving, supposing that it involved in some cases the reverse rule in respect to the approach to railway stations, would be offset by nothing appreciable in locomotive travel.

The course of these cross-roads would be generally nearly parallel, with such deflection from directness only as would be required to secure ease of grade and convenience of drainage, at little cost for excavation and embankment. Their course will generally be coincident also with that of the trend of the valleys and of the currents of the water courses on the hill-sides. This fact will, to a certain extent, influence their location between stations and landings. The present village streets, especially those along the north shore, would establish the initial point for a considerable number, particularly such of them as lead to the ferry landings. In the interior, each railway station would establish an objective point for a road approaching from each side. At present, stations occur at intervals of one mile on the south side track, that being the distance apart at which the old transverse highways of the island are generally found. It is to be expected that in the early future, if the interior of the island increases in population at all rapidly, double the present number of stations, each to be called at by alternate trains, will be demanded. These will be established as nearly as practicable midway of those existing, and it being assumed that the same rule will serve on the projected North Side Railway, the position of roads at half-mile intervals is thus approximately indicated.

Taking the ferry landings, the positions and probable positions of railway stations, the lines of water courses and intermediate ridges which it would be necessary to accommodate, and the advantage of maintaining, where practicable, an approximate equidistance between the roads, a series of lines would be formed, which, with the intersecting high-roads, would subsect the whole island into blocks having a general width of half a mile, and an average length of about a mile.

This having been accomplished, the question is in order whether a judicious limit has not been reached, and whether the further extension of our plan had not better be left to local and private enterprise? We shall leave this question open to your Commission, taking care in

further elaboration to avoid as far as possible any elements which will involve additional highways as a necessity. We shall, however, offer reasons why in our judgment it may be best to proceed one step further with the general plan, doubling again the number of cross-roads.

Looking forward a brief space, and making but moderate allowance for the effect of increased facilities of access and conveniences of house-keeping, and of the advertising influence of the mere adoption of a broad and comprehensive scheme of improvement, and especially for the consequences which will result from the adoption of means adapted to relieve the island of malaria, and give it for the first time the full benefit of its unequalled latent advantages of climate—making the least hopeful allowance for the effect of these proposed improvements, an early large demand for land in the interior and back parts of the island must be anticipated, and of a different character from any that has yet been experienced.

We have endeavored to show more particularly in our first chapter, the space which each of the largest class of purchasers will be likely to want. Along the shore, especially near the steamboat landings, and in the interior near the railway stations and existing villages, the competition for land for domestic business purposes and for the residence of those to whom distance from the boat or station would be objectionable, may be sufficient to make it desirable that it should be readily divisible into lots of from one to two hundred feet in depth. Elsewhere, universally, it should be practicable, without a special process of laying out roads, to divide all land into villa plots as small at least as five acres. With roads averaging half a mile apart, plots of five acres, each occupying half the space between two roads would necessarily have a depth of disproportionate length to their frontage, being 1300 feet to 170, which would be generally objected to. With roads laid out at a quarter of a mile apart, a five acre lot would have a depth of 660 feet, with a front of 330 feet, which is a very good proportion. Again, if lots of about one acre are required, they would be obtained with 150 feet front on streets opened at intervals of 600 feet between the laterals of the general system. Another reason remains, before stating which, however, it will be necessary to advance our drainage plan.

We have argued that thorough-drainage must be the first object of any valuable scheme of general improvement for the island, and have admitted that such drainage must be effected largely by individual undertakings. It is quite evident, however, that not much can be expected of individuals, unless suitable channels are open to them at no great

distance for taking away the water which their private drains are designed to collect. Nor can much be expected of volunteer associated efforts for this purpose so long as they shall remain hampered by the almost insurmountable difficulty of first obtaining unity of opinion, concert of action, and equality of convenience, among a considerable number of neighbors. All may be convinced and resolved, but the moment when all are agreed as to all the particulars necessary to be settled, and when all are prepared to incur the expense, is never reached. The establishment of public drains at frequent intervals would obviate these difficulties by allowing each individual to consult his own convenience as to time, and the same means would provide outlets for the proper drainage of the highways, without which good roads are an impossibility.

Precisely at what intervals such public drains should be constructed, is a question depending on the peculiar conformation of the surface and character of the underlying strata, to be determined only by a careful examination of each particular area. Convenience and efficiency, however, require, in our judgment, that in no case should any land-owner be compelled to carry the main of his private drainage more than a quarter of a mile before reaching an outlet in a public drain. This would require public drains to be formed at a distance apart, never exceeding half a mile, throughout the island, and this we shall assume as a maximum.

We have already shown the objections to open drains, saying nothing of the inconvenience and danger which they occasion otherwise; the prime object of drainage is liable to be defeated, and the evils designed to be remedied by their construction to be aggravated, whenever the flow of water in them is obstructed. Obstruction is constantly liable to occur from vegetation growing in their channels and along their margins, from leaves and other debris delivered by the winds, from the treading down of the banks by cattle seeking water, cool standing places and lush herbage in hot weather; from stepping-stones thrown in by wanderers; from the fall of neglected bridging, and from carelessness in conducting agricultural operations on their banks. Open drains, therefore, are to be avoided as far as practicable, the limit of practicability being one of expense.

The common form of roadside gutter is inefficient, expensive to keep in order, especially on steep hill-sides, and it is often liable, as we have shown, to all the objections which apply generally to open drains.

That roadside gutters may be kept moderately narrow, shallow, smooth and tidy, no large volume of water must be allowed to accumu-

late in them. They must therefore be provided, at frequent intervals, with outlets to the general system of public drains.

It is obviously undesirable that public drains should cross private fields or pleasure-grounds, where this can be conveniently avoided.

In the larger part of the island the drainage system has to be adapted to two quite distinct districts; the first a high-land district, having frequent slopes, which end, often abruptly, in the low-land plain which forms the second. In the descent of these slopes a drain-pipe of given calibre would carry much more water than it would upon the grade at which it would be necessary to lay it on the plain below, and a volume of water which would move with lazy flow in a ditch of given dimensions on the plain, if turned into a similar channel upon the hill sides, unless it were made very expensively or were laid out in a very long and circuitous course, would soon establish a gully; it is, therefore, especially desirable to avoid the necessity of a resort to open drains above the base of the higher and steeper hills. We estimate that all the drainage water which can be collected upon the hills (certain extraordinary circumstances, to be hereafter provided for, being excepted) might, if required, be carried across the lower ground by a series of open drains half a mile apart, and above these in pipes which, even at the point of discharge, need never exceed 15 inches in calibre. (If the drains were to be placed much further than half a mile apart, a far more expensive pipeage would be required near the base of the hills, the rate of cost increasing much more rapidly than the size)

But although 15 inch pipes, half a mile apart, would take all the water of the hills under ordinary circumstances, economy, safety and convenience would be greatly better consulted, in many cases, by the use of smaller pipe at more frequent intervals. This gives the additional reason which was promised for providing in your plan for highways at a less distance than half a mile. It would not be desirable to construct the intermediate roads, or lay drains upon all the lines proposed to be established for them, at once, but in the study of the drainage system it would be a great convenience and matter of economy to be free to do so occasionally.

Where there are existing highways, or where they are immediately required, crossing the lowland regions in a direction transverse to the shore line, at intervals of quarter of a mile or less, as generally along the north and east sides of the island, it is to be presumed that pipes would be laid in them; as a general rule they would not need in these cases to exceed eight inches of calibre, as by means of lateral channels each volume of water descending from the hills could be distributed, on reaching the flatter grades, to a number of outlets.

We are now prepared to define a considerable part of the framework of a highway and drainage plan, which we present in a series of propositions, as follows:

SCHEME OF IMPROVEMENTS TO BE HAD IN VIEW IN THE STUDY OF A NEW
PLAN FOR STATEN ISLAND.

I.

WESTFIELD HIGH-ROAD.—*A highway not less than one hundred feet wide from Tottenville to New Brighton Point, by the most direct course which shall be found consistent with ease of grade and reasonable economy of construction.*

II.

NORTHFIELD HIGH-ROAD.—*A similar highway from the western part of Northfield to New Brighton Point.*

III.

SOUTHFIELD HIGH-ROAD.—*A similar highway from the western part of Southfield to New Brighton Point.*

IV.

BRIGHTON PLACE.—*At the point of junction of the three high-roads, above specified, an open place on the water side, not less than four hundred feet in length upon the shore and two hundred feet deep.*

V.

SHORE ROAD.—*A road not less than one hundred feet wide leading from the south end of New York Avenue, Ulfston, southward to the shore; thence, westward, along the shore, or as near it as a reasonable economy will admit, to New Dorp Plains, then curving to the northward so as to make a convenient junction with the Southfield high-road north or north-east of the Great Kills; thence, westward, keeping the Bay in view, to Tottenville; thence, along the shore,*

or as near the shore, either upon salt marsh or upland, as shall be found consistent with moderate directness and economy, until a connection is made with the existing shore road on the north side of the island.

VI.

TRANSVERSE ROADS.—*Roads not less than fifty feet wide crossing the highroads wherever the topography admits, at intervals not exceeding, on an average, half a mile, nor nearer together, on an average, than a quarter of a mile.*

VII.

PUBLIC DRAINS.—*Public Drains, at intervals not exceeding half a mile, nor nearer together, on an average, than quarter of a mile, throughout the Island, the salt marshes alone excepted, to be adapted to serve as outfalls for the thorough-drainage of all the lands between them, and also to receive the surface drainage of the highways.*

VIII.

UNDER DRAINS AND ROAD DRAINS.—*Wherever the public drains will be required to receive no more water than can be safely carried in a pipe of fifteen inches calibre, they may be covered drains, laid as far as practicable within the bounds of public highways.*

It may be presumed that under the last rule, drainage would begin near the "divide" of the water shed, with three inch tile of common brick clay, laid with collars; and that in most cases a close six inch pipe, laid on each side of the road, would be the largest required, until an open water course, natural or artificial, should be reached. A cheap form of silt-basin, made probably of cement, would be placed at intervals of from two to three hundred feet, into which land-owners would be permitted to carry their mains. The surface drainage of the roads would reach the pipe also through the silt-basin, entering it by a grating on the surface; this grating in the rural districts might be of wood. To avoid the expense of a gutter of stone, which would nearly double the ordinary cost per foot of the system, we should propose that

highways out of villages be generally laid out of sufficient width to admit of their being constructed with turf gutters. These have elsewhere been found adequate to the duty that would be required, and with the arrangement suggested, would be liable to gully probably on no grade necessary to be adopted on the island. Assuming a wheelway of twenty-two feet as the minimum for the most secluded neighborhood roads, the gutters would require as much as four feet on each side, beyond which, the turf should be extended with a very flat slope four feet further, to admit trees to be grown healthfully and without inconvenience. The advantage of fairly grown road side trees, as an adjunct to the drainage system and as air purifiers, has been sufficiently shown, their advantage as embellishments needs no argument. The arguments against them are all based on the assumption of a bad ground plan and an ignorant and inconsiderate administration. We assume that in all roads to be hereafter laid out proper provision will be made for them. In a highway fifty feet wide, there would remain six feet on each side of the tree border for walks. The gutters should be kept free at public expense, and should be adapted in form to be rapidly mowed, rolled and swept by a small horse machine of special construction, which would make the cost of keeping them from five to ten dollars a year per mile of road. Whenever business upon any such road so much increases, that twenty-two feet should be found inconveniently narrow for a wheelway, stone or brick, gutters could be substituted for turf, and iron for wooden gratings, and the wheelway enlarged to thirty feet. The sidewalks could also be extended and flagged to the curb if necessary, making them ten feet wide. These remarks are intended to show simply the practicability of applying the general plan to the highways not more than fifty feet wide, that is to say, the narrowest neighborhood roads, without excessively expensive details. Its adaptation to wider roads, and especially to the high-roads, needs no explanation.

It remains to define the form of the open drains which shall be used where the amount of water to be provided for is liable to exceed the capacity of a fifteen inch under drain, the object being to reduce the necessary evils to the lowest point which shall consist with economy of original construction. The inside slopes of the canals of this state, approved by half a century of experience, have two of base to one of vertical measurement; channels for drainage not being subject to the abrasion of boats, may not require as much, but it is a common sense rule that no side slope should be formed artificially with a greater slope than is established by nature where banks of similar material are undermined by streams. An examination will show that a slope of at

most one to one is that fixed as a *maximum* in the ordinary material of the island. We therefore add the following to our series of propositions.

IX.

OPEN PUBLIC DRAINS.—*Open drains either to be bored, or to be cut with side slopes of never less than one foot horizontal to one of vertical measurement, and whenever such side slopes are impracticable, to have smooth floors of firm material, and such wall as may be necessary to prevent caving or crumbling of sides.*

The danger of air-poisons rising from all water courses which are liable to run dry, or nearly so, in the heat of summer, especially if there are many dwellings near them, has been fully explained; without further argument, therefore, we add

X.

NATURAL WATER COURSES.—*The beds of all open water courses to be made sufficiently firm, smooth and dishing towards the deepest part of the channel, to prevent any lodgment of the water, as the streams shrink in summer, in pools where it will be liable to stagnate.*

XI.

OCCASIONAL FLOOD COURSES.—*Wherever any open drain or water course is liable to great fluctuations of service, as to flood by storm, and stagnation by drought, provision if practicable, to be made for laying a pipe below such open drain, the use of the open drain being to dispose safely of floods which the pipe cannot carry.*

Certain extreme cases above alluded to remain to be specially provided for. The water, for example, falling during a heavy storm upon the eastern side of Signal Hill, is mainly collected before it reaches the bottom, in a series of depressions, and then combined in one stream, the outlet of which is near Stapleton Landing. Generally in summer, the channel of this stream, south of the head of Rocky Hollow, is dry on the surface, and even below that point it often carries, in time of

drought, nothing but a dribble, which breeds deadly poison; yet in a single night it has risen so rapidly as to burst its banks and destroy property to the amount of many thousand dollars, and even cause loss of life. Here, then, are two extreme conditions to be provided for in the same locality, and in each case the question whether our scheme is adequate, may be a matter of life and death. That the present arrangements are really murderous, there can be no doubt. The cost of providing a covered conduit sufficient for all occasions, would be very large.

It has occurred to us that a channel for a part of this water might be opened to the southward, and we find that this can be done by a light excavation. For ordinary conditions a moderate sized pipe-drain might be laid below the present bed of the stream, as already proposed, and instead of a deep open trench sufficient for storm waters, which, would be very costly to maintain, and always liable to become a nuisance, we should propose a broad and gently sloped turfed depression. At certain points, as at the mouth of the Clove for instance, this depression would be made sufficiently large and deep to serve as a storage pond, taking up a large body of water during heavy storms, and giving out north and south no more than conduits of moderate size below would be adapted to carry with safety. The object of the arrangement, it will be readily seen, is to avoid what would otherwise be the dilemma of a very expensive system of large covered drains, or a very inconvenient and dangerous system of large and deep open drains, canals in fact. The ground required in this case is now mainly swampy, a "seed bed of malaria," and of little value. The arrangement proposed would make it wholesome, useful, and ornamental.

It will be obvious that the plan proposed by Mr. Root, before referred to, for the shore road, may be readily modified, whenever circumstances shall render it desirable, so as to admit of the introduction of such an arrangement as has been described, the exterior highway lines being expanded and the central row of trees carried around the depression. The plan has also the advantage that if between any two crossing roads it should, for any future village purpose, become desirable to establish a market place or open ground, or merely to gain additional wheelway room, it can be readily done by removing the central row of trees. Should such a necessity arise where the proposed depression has been introduced, it could also be met by the construction of a sufficiently large culvert or pipe drain, and covering and levelling up above and about it, to the grade desired.

An arrangement of this nature, nearly continuous, but varying in breadth and depth, would have considerable advantages if introduced

parallel to and a little below the steep slopes terminating the highland district, as all the water flowing from them might thus be arrested and distributed as before suggested to find its way thence to the sea through any required number of channels of moderate capacity.

In many situations where its use would be thus desirable, the land is at present unoccupied by houses, uncultivated, often boggy, and generally highly malarious, and would probably be the last in which proper remedies would be applied by private enterprise, because being low, it would, even if improved, be the last to be selected for private residences. For these reasons we are disposed to think that it might profitably be made a somewhat prominent and important feature of the general plan of roads, especially about the base of the hills. It may be well, therefore to try to realize its landscape character a little more distinctly.

This may be done by imagining that a shallow stream has formerly flowed upon the course to be followed by a highway, close upon the banks of which trees have grown picturesquely and that back of the trees on each side a roadway and walks have been formed. The water of the stream having been cut off, and turf having established itself in the old bed, the result would have the character of the safety-valley we suggest. For a short time after storms it would be covered with water which would rise through occasional outlets from the pipe drain below; soon subsiding, it would leave the turf perfect, and available as a continuous pleasure ground. At certain points this plan has other advantages which will be hereafter indicated.

We give you the suggestion as our 12th proposition.

XII.

FLOOD REGULATORS.—*On any line of drainage which it may be desirable to follow in laying out a public highway, and the stream of which is liable to great fluctuations, a sufficiently deep and broad valley, or depression of the surface, to serve as a catch-water drain, safety pond and flood regulator; the surface of the ground being sodded and otherwise prepared, so as to have an agreeable appearance, and whenever practicable, fitted to serve as a public green, the road way being carried on each side of the depressed ground.*

It may be noticed that each of the high roads as proposed to be laid out, with no object in view except that of offering the shortest practicable route to New York from the greatest number of house sites on the Island, will, if properly drained and constructed and especially if wisely embellished in planting, incidentally make available and attractive a series of sites fronting upon itself, upon ground which is now mainly useless, unoccupied by houses, uncultivated, and of which there is less prospect that it will be soon turned to much account in the ordinary course of improvement than almost any other on the island. Beyond, at furthest, the first mile, the value of land required to be taken would be low and the benefit to adjoining property would be more than enough to compensate the cost of the roads, provided always that adequate measures are at the same time taken to lift the character of the Island as a whole in public esteem.

It will also appear, if the whole system which has been thus far suggested, is carefully studied, that it is calculated to bring especially into public notice and favor the very districts which have been pointed out as those having the most advantages for collecting, storing and distributing water. Two, if not three or more of the safety-valley roads, which would take especially the character of pleasure roads, would lead toward them, the Westfield high-road would run for four miles through or beside two of the dales, and would cross the third, and both the Northfield and Southfield high-roads would, by short, necessary and important branches, connect with them.

There is no room for doubt then that if the general suggestions of our report thus far should be carried out, there will be a rapid and large rise in value in the land of these dales. A paint mill, a tobacco manufactory and a large brewery, have already been established hard by one of them. There are five places of burial, three of them recently established, upon the hills overlooking them, though fortunately only one drains toward them, and there are already within a mile of them settlements much too dense to consist with the preservation of water collected on the surface in a state of wholesome purity. Not only will all the dale land rise much in value, then, but its occupation in such a way or in such degree of domestic density as would destroy its suitability as a field of water collection will almost certainly occur before many years.

We have before referred to the peculiar situation of the island, in that, while likely to be the residence of a large and closely settled population, its authorities can not fall back for water, as is usually done, upon collecting basins in elevated highland pastures, where serious sources of contamination are easily guarded against.

We show by analysis that already in the denser settlements along the shore the well water contains nearly five times the amount of organic and dangerous impurity that is found in the water collected by the surface of these dales. (See Appendix, pp. 102-104.)

It will be evident, upon a review of all the circumstances, that the value of these dales, if held as public property, will by and by be almost beyond price, while the cost to the public of obtaining them is liable soon to be vastly greater than at present. The immediate duty thus suggested is in our judgment of the most imperative character and gives grounds of justification, which could not well be made stronger, for throwing upon posterity some share of the cost.

We are by no means prepared to completely plan a water system for the island. Our figures of elevation are taken from the coast survey chart, which gives nothing within contours of twenty feet. We have not been able to properly gauge the streams, and all our data must be taken as roughly approximate. Under any conceivable plan, however, large places will be wanted at several points in these three dales for impounding ponds and other essential parts of an aqueduct system, as will all the land occupied by and adjoining the streams flowing through them. If not absolutely essential to hold a large area on either side of the water courses from end to end, it will be quite necessary to restrict the amount and the character of its occupation, and it will certainly be desirable to keep it entirely free from dwellings and stables. Observing that your Commission contemplates a public park, (having appointed a committee on that subject,) the question occurs whether there would be any objection to its use as a public ground for recreation. We are fortunately able to answer it with confidence, a similar question having been raised some years since in Pennsylvania, and having been referred by the legislature to a Commission of leading citizens of Philadelphia. They obtained the assistance of the best engineers, chemists and sanitarians of the country and their decision was that with proper care such use of a water preserving ground was unobjectionable. The result gives the City of Philadelphia a noble suburban park of nearly three thousand acres, this being the extent of the area sloping towards the impounding pond of the Fairmount Water Works, which it had been thought desirable to especially guard from sources of contamination.

In the case of Staten Island, it would be a simple plan for the public to form a park similarly designed, to include nearly all of the valleys and hill sides which would constitute the areas of precipitation for the water to be collected. Such a park for the Eastern water works would

be four miles in length and at least one in average breadth, the Western part of the island still remaining to be provided for. It would occupy a moderately central position, would turn to good use a large extent of land which is at present benefiting nobody, but is much of it a nuisance, and relatively to the City of New York would possess somewhat of the character of the great suburban parks about London, Paris, and Berlin. This plan has great attractions, but it involves the purchase of a large extent of valuable real estate on the upper hill sides, and although we are confident that, as has happened in all similar cases, the advance in taxable value of the surrounding properties would eventually more than compensate for the required outlay, provided a thorough-drainage system should at the same time have been carried out over the whole island, we are constrained to doubt the practicability of so large an undertaking.

We propose, instead, that highways should be laid out on the slopes of the three dales we have indicated, one on each side of each, in such a manner as to leave the water-course generally midway between the two, the intermediate dale-bottom being in the upper parts not more than three or four hundred feet wide, but becoming gradually broader as the points are approached which would be suitable for impounding reservoirs, about and above which there would in each case be a large meadow. This space we should propose to clear of buildings, (there are none upon it now of much value), thin out the trees to open groups, and with little or no grading lay it down to grass. The ground thus prepared would have much the character of the safety-valleys before described, except that it must be broader and more diversified. We shall speak of it as the Water Glade.

The outlines of the water-glade would be curving in correspondence with the present forms of the inclosing hills, its bounding roads being carried down the slopes, always upon easy grades, giving occasion for a series of small bays and headlands on its border.

Outside the bounding road we should recommend that another space, having a depth of fully three hundred feet, should be acquired, which should be cleared of everything likely to occasion contamination, and the surface prepared as might be found most desirable for the collection and discharge of water upon the water-glade, by culverts under the highway. This having been done, and the ground on each side of all branches of the water-course being reserved, the remainder of the exterior ground, which we shall designate the Overdale, might be disposed of on long building leases, or possibly sold with certain rights reserved, also with restrictions against burial of the dead, against various manufactures, limiting the number of dwell-

lings, providing against cellars, manure pits or cess-pools, unless cemented, and with cemented outlets to a common pipe which would be provided in the highway, to discharge below the impounding ponds, and under whatever other conditions should, upon careful consideration, be thought desirable. There would perhaps be three hundred acres of the Overdale, which when properly prepared and regulated, might safely be occupied by detached dwellings.

On the south side of Dongan-knoll there is a favorable place for a distributing reservoir for the upper hill country, and we should propose to acquire this ground and connect it, together with the knoll itself, with the heads of each of the water-glades.

We should also recommend the acquisition of a tract of land of from five to ten acres suitable for a distributing reservoir for Clifton, which would be found at an elevation of two hundred feet on Fox Hill, and another with reference to Stapleton and New Brighton at some point on Signal Hill.

The Martling Dale lies exactly on the line of the proposed Westfield High road, which would here constitute part of the bounding highway of its water-glade. The west end of the Millsdale would extend to the Fresh Kills near Richmond. The Manor Dale would be reached by a short branch from the Northfield High-road, and thus opened to pleasure travel from Jersey as well as New York. By carrying a branch of the drainage valley proposed to be formed below the hills at Concord up the Clove, this feature in the Southfield High-road would become to all appearances a branch of the water-glade; we should propose to extend it in one fork to the reservoir ground at Fox Hill, about which a drive and walk constituting a local promenade for Clifton should be formed, and in another, east of the Oldtown road, to the Shore-road at the South beach, where, as already suggested, it would merge in the central feature of Mr. Root's plan. We should propose a similar connection with the proposed reservoir ground on Signal Hill, the distance to which would not exceed half a mile probably, and a third branch following down the glen below the Martling Pond to the North shore, by which means some of the most charming sylvan scenery on the island would be appropriated at little cost and with great incidental advantages to the neighborhood.

To the amount of land which should be acquired and held by the public simply from considerations of economy and prudence with regard to water supply and drainage, an addition of a tenth would enable a pleasure-ground to be laid out, which, if less desirable than the large park before suggested, would certainly have a highly interesting and attractive, as well as wholly original character.

One element in the value of a park is the advantage which house sites fronting upon it have in not looking directly upon the face of other houses but rather upon a permanent verdure. This advantage our plan would secure to a frontage from fifteen to twenty miles in length, (not counting the Shore-road, much of which would have an outlook finer than that upon any park.) Regarded as a park scheme, much of the Glade is already very charmingly planted, the western landscape as seen from all parts of the Manor Dale has great breadth and beauty, while from the Dongan-knoll, which is the central feature of the system, the views, with some little improvement of the foregrounds, would be really magnificent, comprehending a grand sweep of the horizon in blue water on one side, in blue hills on the other.

The advantages of such a public ground in giving increased value to all property on the island we hardly need argue. It is sometimes said, however, that the island is a park in itself and has no need of any special public ground. It may be pertinent, therefore, to recall the fact that no part of the island is today more of a park than Rocky Hollow, or the Bloomingdale road north of Union Square, or the greater part of the Twenty-first Ward of New York, was fifty years ago. Nowhere on Staten Island is there a landscape or even a glimpse of agreeable scenery which belongs permanently to the public—which no man has the right to obstruct and destroy in pursuance of private and selfish ends.

Without advocating the immediate construction of water-works, we may observe that the measure we propose would give Staten Island control of an opportunity for supplying its eastern and northern parts with pure water at a smaller cost for original construction of works and annual maintenance and extension, than a similar advantage could probably be obtained by any other considerable rural suburban district.

The conditions upon which this opportunity depends, beyond those which we have already emphasized, are to be found mainly in the nearness of the sources of water to the points at which its distribution will be required; the commanding height attainable for distributing reservoirs, by which the requirements of size and consequent cost of pipeage may be kept low; the location of the communities to be served within a circular sweep of short radius from the center of the system—the situation of the Dongan-knoll being almost exactly equidistant from tide water at Factoryville on the north, and New Dorp on the south, Stapleton on the east, and the Fresh Kills near Richmond on the west;—and finally in the limit to outward and scattered extension which is imposed by the sounds and bays, and the certainty that the principal increase of population will tend to bring the point of greatest

average annual consumption constantly nearer the principal point of supply.

We submit that the Island cannot afford to run the least risk of losing this opportunity.

The preparation of the Glade and its connections with the safety valleys and the distributing reservoirs, so far as necessary to give unity of character to the whole territory proposed to be acquired for the public, as a pleasure ground system, would involve very little expense for construction. The ground simply requires the treatment that a farmer would ordinarily use for making a permanent meadow. We propose no constructed interior roads or walks, and the general character aimed at being that of a rural common rather than a park, the turf would be cropped by sheep, and its maintenance involve no expense. The bounding road would be a common highway, and the expense of its maintenance would be a charge upon the householders of the Overdale fronting upon it.

The propositions in respect to this subject which we present for your formal consideration, are almost necessarily somewhat indefinite in terms, the object being to leave much freedom for further study.

XIII.

EASTERN WATER PRESERVE AND PUBLIC COMMON.—*A system of water works for the eastern part of the Island to be had in view, the suggestion being favored of appropriating to this purpose so much as is desirable of the ground designated in the report before the Commission as the Martling-dale, the Manor-dale and the Mill-dale, with reference to Impounding Reservoirs, and the preservation of the purity of the water to be collected in them. An appropriation to be made of from five to ten acres of ground upon Fox Hill and upon Signal Hill, selected with reference to the double purpose of distributing reservoirs and public recreation grounds, and these sites to be connected by arms from fifty to one hundred and fifty feet wide, with the ground proposed to be appropriated as a water preserve, and the whole designed to serve as a public common.*

The system of water works which has been indicated has been studied especially with reference to supplying the population dwelling east of the Kills, (Fresh and Great). It might for a time contribute also to the supply of the community living west of the Kills. But

the necessity of an aqueduct supply will not nearly as soon, probably, be pressing in that part of the island, and when it is so it will doubtless be thought prudent to provide for it from local sources. These will be found in the water-shed of Benham's Brook and Lemon Creek, the collections of each of which may be united in one scheme to supply the whole, or perhaps better, may be used distinctively for separate districts. The amount of water estimated to be due from both, supposing the usual yield, would be adequate under proper conservance to meet the necessary requirements of a population many times as large as the present. There are elevations centrally situated within the districts of altitude sufficient to give the water satisfactory distribution by gravitation. The early acquisition of ground for this purpose would, it is believed, be a measure of prudence and economy. Nor would its early appropriation as a public common, maintained as heretofore suggested, be without considerable advantages. We submit therefore our last proposition as follows:

XIV.

WESTERN WATER PRESERVE AND PUBLIC COMMON—*Suitable grounds for the collection, storage and distribution of the waters of Lemon Creek and Benham Brook, to be selected and laid off, and these to be of the extent required to admit of a system of conservation and management, in all respects similar to that proposed to be had in view for the Eastern Water Works.*

It may be acceptable to you to learn that while very great interest in our duty and a disposition to assist us has been generally manifested by citizens of the island, for which we are grateful, we have seen no evidence of an intention to unworthily influence our judgment. We have received no hint from any person, in the Commission or out of it, of private or local interests, nor was there a soul beside ourselves who, before this reading, had any knowledge of our intended recommendations.

We beg to return thanks, on your behalf, to Doctor H. I. Bowditch, of Boston; to Professor J. S. Newberry, of the School of Mines; Prof. C. F. Chandler, of Columbia College; to Professor A. F. Liautard, of New York; and Professor James Law, of the Cornell University; to Messrs. G. K. Radford, of Buffalo, L. Y. Schermerhorn, of Chicago, H. D. Fisher, of New York, Civil Engineers, and to S. C. Hawley, Chief Clerk of the Police Department, R. S. Guernsey, Esq., and Homer

Morgan, Esq., of New York, and to Messrs. Crooke, Elliott, Meyer, Minthorne Tompkins, John C. Thompson, D. R. Hitchcock, Jacob Garretson, and Peter L. Cortelyou, of the Island, for valuable contributions.

We are also under obligations, in your behalf, to the physicians of the Island generally, and more especially to the following gentlemen, who have answered our inquiries with painstaking care, or otherwise particularly aided us: Doctors Edgar, Golder, Spencer, E. and G. Hubbard, and Andrews, of Westfield; Doctors Anderson, Lea and Richardson, of Edgewater; Doctors Walser, Bogart and Van Rensselaer, of New Brighton; Doctor Clark, of West Brighton; Doctor Martindale, of Port Richmond; Doctor Satterthwaite, of Mariner's Harbor, and Doctors Ephraim Clark, and Isaac L. Millspaugh, of Southfield.

We shall conclude by gathering in one scheme the several propositions to which our study has led. It is by no means intended to cover all obvious requirements of improvement, but to establish a framework, and give a key to the character of what should be had in view. Accepting the estimate which we have taken, and have attempted to justify, of the opportunities and dangers of the island, we believe that we have given you good reasons for adopting each proposition.

With the problem of ways and means for carrying out the proposition we have nothing to do, nor, as we understand, has your Commission, further than as it affects the question of its practicability; and even on that point the question is not merely what is practicable now, but what is to be practicable? What can be expected of Staten Island? It is for you to determine whether our recommendations assume too much or too little in this respect.

We respectfully recommend you to adopt the following :

SCHEME OF IMPROVEMENTS TO BE HAD IN VIEW IN
THE STUDY OF A NEW PLAN FOR STATEN ISLAND.

I.

WESTFIELD HIGH-ROAD.—A highway not less than one hundred feet wide from Tottenville to New Brighton Point, by the most direct course which shall be found consistent with ease of grade and reasonable economy of construction.

II.

NORTHFIELD HIGH-ROAD.—A similar highway from the western part of Northfield to New Brighton Point.

III.

SOUTHFIELD HIGH-ROAD.—A similar highway from the western part of Southfield to New Brighton Point.

IV.

BRIGHTON PLACE.—At the point of junction of the three high-roads, above specified, an open place on the water side, not less than four hundred feet in length upon the shore and two hundred feet deep.

V.

SHORE ROAD.—A road not less than one hundred feet wide leading from the south end of New York Avenue, Clifton, southward to the shore; thence, westward, along the shore, or as near it as a reasonable economy will admit, to New Dorp Plains, then curving to the northward so as to make a convenient junction with the Southfield high-road north or north-east of the Great Kills; thence, westward, keeping the Bay in view, to Tottenville; thence, along the shore, or as near the shore, either upon salt marsh or upland, as shall be found consistent with moderate directness and economy, until a connection is made with the existing shore road on the north side of the island.

VI.

TRANSVERSE ROADS.—Roads not less than fifty feet wide crossing the high-roads wherever the topography admits, at intervals not exceeding, on an average, half a mile, nor nearer together, on an average, than a quarter of a mile.

VII.

PUBLIC DRAINS.—Public Drains, at intervals not exceeding half a mile, nor nearer together, on an average, than quarter of a mile, throughout the Island, the salt marshes alone excepted, to be adapted to serve as outfalls for the thorough-drainage of all the lands between them, and also to receive the surface drainage of the highways.

VIII.

UNDER DRAIN AND ROAD DRAINS.—Wherever the public drains will be required to receive no more water than can be safely carried in a pipe of fifteen inches calibre, they may be covered drains, laid as far as practicable within the bounds of public highways.

IX.

OPEN PUBLIC DRAINS.—Open drains either to be boxed, or to be cut with side slopes of never less than one foot horizontal to one of vertical measurement, and whenever such side slopes are impracticable, to have smooth floors of firm material, and such wall as may be necessary to prevent caving or crumbling of sides.

X.

NATURAL WATER COURSES.—The beds of all open water courses to be made sufficiently firm, smooth and dishing towards the deepest part of the channel, to prevent any lodgment of the water, as the streams shrink in summer, in ponds where it will be liable to stagnate.

XI.

OCCASIONAL FLOOD COURSES.—Wherever any open drain or water course is liable to great fluctuations of service, as to flood by storm, and stagnation by drought, provision, if practicable, to be made for laying a pipe below such open drain, the use of the open drain being to dispose safely of floods which the pipe cannot carry.

XII.

FLOOD REGULATORS.—On any line of drainage which it may be desirable to follow in laying out a public highway, and the stream of which is liable to great fluctuations, a sufficiently deep and broad valley, or depression of the surface, to serve as a catch water drain, safety pond and flood regulator; the surface of the ground being sodded and otherwise prepared, so as to have an agreeable appearance, and whenever practicable, fitted to serve as a public green, the road way being carried on each side of the depressed ground.

XIII.

EASTERN WATER PRESERVE AND PUBLIC COMMON.—A system of water works for the eastern part of the Island to be had in view, the suggestion being favored of appropriating to this purpose so much as is desirable of the ground designated in the report before the Commission as the Martling-dale, the Manor-dale and the Mill-dale, with reference to the Impounding Reservoirs, and the preservation of the purity of the water to be collected in them. An appropriation to be made of from five to ten acres of ground upon Fox Hill and upon Signal Hill, selected with reference to the double purpose of distributing reservoirs and public recreation grounds, and these sites may be connected by arms from fifty to one hundred and fifty feet wide, with the ground proposed to be appropriated as a water preserve, and the whole designed to serve as a public common.

XIV.

WESTERN WATER PRESERVE AND PUBLIC COMMON.—Suitable grounds for the collection, storage and distribution of the waters of Lemon Creek and Benham Brook, to be selected and laid off, and these to be of the extent required to admit of a system of conservation and management, in all respects similar to that proposed to be had in view for the Eastern Water Works.

Respectfully,

FRED. LAW OLMSTED,
ELISHA HARRIS,
J. M. TROWBRIDGE,
H. H. RICHARDSON.

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I.

COMPARATIVE PROGRESS OF POPULATION OF STATEN
ISLAND AND OF OTHER SUBURBS.

SUMMARY OF THE CENSUS.

RICHMOND COUNTY.	1865.	1870.	DIFFERENCE
Castleton	7,883	9,519	1,636
Middletown.....	6,866	7,589	723
Northfield	5,201	5,949	748
Southfield	4,407	5,072	675
Westfield	4,052	4,905	853
TOTALS	28,409	33,044	4,635

TOWNS IN WESTCHESTER COUNTY.	1865.	1870.	DIFFERENCE
Yonkers.....	12,756	18,320	5,564
Westchester.....	3,026	6,166	3,140
West Farms.....	7,333	9,334	2,001
Morrisania.....	11,691	19,637	7,946
Rye	4,675	7,152	2,477
Cortlandt, including Peekskill.....	9,393	11,695	2,302
Greenburgh, including Tarrytown..	8,463	10,876	2,413
Ossining, including Sing-Sing	6,223	7,798	1,515
Eastchester.....	5,615	7,494	1,879
W. Plains.....	2,122	3,000	878
Bedford.....	3,465	3,700	235
New Rochelle.....	3,968	3,901	67 less.

TOWNS ON LONG ISLAND.	1865.	1870.	DIFFERENCE
Flushing.....	10,813	14,673	3,860
New Lots.....	5,009	9,805	4,796
Gravesend and Flatlands.....	3,531	4,417	886
New Utrecht.....	3,394	3,298	96 less.

II.

ANALYSIS OF WATERS.

BY PROFESSOR C. F. CHANDLER, OF THE SCHOOL OF MINES.

NOTE—Samples 1, 2, 3, 4 and 5 were selected as follows, under the supervision of this board, and were forwarded to PROF. CHANDLER, under seal, and with no other description than the above numbers. They were obtained during a time of unusual drought, and consequently may be considered as fairly representing the particular characteristics of the water-supply in each of the localities, or from each of the sources we here describe:

Descriptive List of the Waters submitted to Professor Chandler for Chemical Analysis.

SAMPLE No. 1.—From a well in Amos street, Clifton, about twenty feet above tide level; depth nine feet in the ordinary gravel and earth of that district. Well, clean, with clean surroundings, the surface near it being paved and cemented but the subsoil exposed to the ordinary results of defective drainage. Quantity 5 gallons, taken December 10th, 1870.

SAMPLE No. 2.—From a shallow well-spring at the dam of the Mill-pond of Standrig's machine shop, on Willow Brook, about fifty-five feet above tide level; Northfield. Quantity, 6 gallons, taken December 9th, 1870.

SAMPLE No. 3.—From principal inlet of Ketchum's mill-pond, near the road from New Springville to Richmond. The inlet receives some fresh drainage from swamp ditches recently opened, and the surface wash of some soft magnesian rocks, which give the chief impurities. Taken at a point about sixty feet above tide level. Quantity 5 gallons. December 10th, 1870.

SAMPLE No. 4.—From the upper pond of Abraham Britton, Esq., on east side of Clove road, two days after heavy rain. Height about one hundred and thirty-five feet above tide-level. Quantity, 6 gallons. December 15th, 1870.

SAMPLE No. 5.—From a well near Franklin avenue, at a point about one hundred feet above tide-level, and from a clean excavation forty feet deep in the magnesian or soapstone rock of the locality. Quantity, 2 quarts, taken December 15th, 1870.

REMARK.—The wells (Nos. 1 & 5), are regarded as fair examples of the village and villa wells. The samples 2, 3 and 4, are specimens of the present natural outflowings from the several dales described in the report.

LABORATORY OF THE SCHOOL OF MINES, }
New York, January 12, 1871. }

Certificate of the Analysis of the Samples of Water from Staten Island, marked Nos. 1, 2, 3, 4 and 5, submitted to me for examination, contain in one U. S. Wine Gallon of 231 Cubic inches.

GRAINS.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Potassa	0.529	0.140	0.091	0.106	
Soda	2.822	0.369	0.345	0.362	
Lime	1.819	0.816	0.846	0.851	
Magnesia	4.397	0.332	1.960	1.149	
Chlorine	3.156	0.486	0.546	0.546	0.728
Sulphuric Acid	2.018	0.140	0.198	0.158	
Silica	1.429	0.804	0.937	0.385	
Oxide of Iron and Alumina	0.233	0.041	0.088	0.204	
Carbonic Acid	5.451	1.447	2.660	1.813	
	21.854	4.575	7.671	5.574	
Oxygen equivalent to Chlorine	0.711	0.109	0.123	0.123	
Total Inorganic matter as left by evaporation ..	21.143	4.466	7.548	5.451	8.519
Organic and Volatile matter	4.283	0.816	0.734	1.397	0.812
Total Impurities left by evaporation	25.426	5.282	8.282	6.848	9.331
Carbonic Acid holding Carbonates in solution as Bicarbonates	5.451	1.447	2.660	1.813	
Water in Bicarbonates	2.230	0.391	1.088	0.742	
Total impurities in solution	33.107	7.120	12.030	9.403	

These bases and acids exist in the water in the following combinations:—

Chloride of Sodium	5.200	0.697	0.651	0.683	
Chloride of Magnesium	none.	0.084	0.203	0.177	
Sulphate of Potassa	0.979	0.260	0.169	0.195	
Sulphate of Soda	0.152	none.	none.	none.	
Sulphate of Lime	2.520	0.035	0.205	0.116	
Bicarbonate of Lime	2.354	3.299	2.203	2.326	
Bicarbonate of Magnesia	15.957	1.084	6.841	3.920	
Oxide of Iron and Alumina	0.233	0.041	0.087	0.204	
Silica	1.429	0.804	0.937	0.385	
Organic and Volatile Matter	4.283	0.816	0.734	1.397	
Total Impurities as they exist in solution	33.107	7.120	12.030	9.403	
Hardness—Carbonate of Lime or its equivalent ..	4.130	1.430	1.350	1.380	4.210
Oxygen required to oxidise the putrescent organic matter	0.050	0.020	0.020	0.070	0.040

GENTLEMEN.—As I am not informed of the particular sources from which these samples were obtained, I must necessarily limit my remarks upon them to the chemical composition of the waters as developed by my analyses.

Sample No. 1 is a very impure water, it contains an unusually large proportion of organic matter, which, while it is, perhaps, not specially dangerous at present, is liable at times to be a prolific source of disease.

Besides the organic matter this water contains a large amount of alkaline and earthy salts. The former are not specially objectionable, while the latter are anything but desirable. These lime and magnesia salts are injurious in waters intended for domestic purposes; (1) as they render the water "hard," and destroy a certain portion of the soap, when they are used in washing; (2) because when food is prepared with such waters, the full effect of the application of heat is not obtained, meat and vegetables do not become as tender and perfectly digestible as when boiled in soft water; (3), that salts are believed by physicians to cause, when present, in unusual quantity, certain very troublesome diseases, such as indigestion, diarrhoea and dysentery, and even goitre.

This water is probably drawn from the neighborhood of dwellings, and perhaps of stables, and I regard it as unsuitable for domestic use.

Samples numbered 2, 3 and 4 are of very good quality. They contain about the same quantity of organic matter as is usually found in the sources from which the Croton and Ridgewood waters are drawn. The alkaline and earthy salts are not excessive, though there is a marked choice between these three samples of water. No. 2 is decidedly the best of the three; it is remarkably pure, and is of equal quality with the Croton.

Next in the order of purity stands No. 4. No. 3 contains an amount of earthy salts which places it near the dividing line between the good and the impure waters. If the supply of Nos. 2 and 4 is sufficient for the public wants, it would perhaps be advisable to rely entirely upon them, though I think No. 3 may be used with safety.

No. 5 is of about the same quality as No. 3, though somewhat inferior to it, as it contains a larger quantity of alkaline and earthy salts than any of the others, except No. 1, and more magnesia than is desirable; yet it is not contaminated by organic matter.

The *softness* of numbers 2, 3 and 4 is remarkable, and is an important element in a supply for domestic purposes, for the reasons already mentioned.

Respectfully yours,

C. F. CHANDLER,

Professor of Analytical and Applied Chemistry.

To the Advisory Board,

Staten Island Improvement Commission.

STEAM ON COMMON ROADS.

The following extract from an official report of a very cautiously conducted trial of road locomotives is here given, on account of its bearing upon the question of the probable future value of roads of unusual breadth and easy grades, especially when they are continuations of important routes of water transportation, as would be the case with the proposed high-roads, and some of the cross roads, leading inland from landings on the island. There seems little room for doubt that, upon firm, broad roads of easy grades, steam can now be used for the carriage of freight more economically than horses. If roads should now be laid out of ordinary width and grades, upon such routes, leading to localities which are likely to increase very much in population, a demand is very likely to arise, in the early future, for widening and reducing them, which can only be met at the cost of much destruction of property fronting upon them.

The report gives the result of a trial of one of AVELING & PORTER'S Road Locomotives, undertaken by M. Tresca, for the French Conservatoire Impérial des Arts-et-Métiers, at the instigation of the Director, General Morin, and in concert with Professor Fleeming Jenkin, Fellow of the Royal Society of London. The engine, "La Ville de Senlis," with which these experiments were made, is of 14 horse-power nominal, and as will be seen, *drew a load of nearly 80 tons, of 2,240 lbs. each ton*, (exclusive of the engine,) whereas her power is stated to be "40 to 50 tons." The trial of the engine took place at the Sugar Manufactory of Messrs. Lallouette & Co., of Beaurain, near Senlis:

"Messrs. AVELING & PORTER, who have applied themselves to the construction of Traction Engines, have already made a great number for business purposes; so, as it was impossible for us to make sufficiently prolonged trials of these machines at the Exposition, we gladly availed ourselves of an occasion offered at the Sugar Manufactory of Messrs. Lallouette & Co., of Beaurain, near Senlis, to witness a traction experiment with a very heavy load; and we took the necessary steps to register all the mechanical elements of the question.

"These experiments were, moreover, made in concert with Professor Fleeming Jenkin, Fellow of the Royal Society of London, who went into all details, and whose presence gives to the results arrived at, a character of security that increases their importance.

"The motive power of the engine consists of a single cylinder, 11 inches diameter, with a piston stroke of 14 inches.

“The diameter of the driving wheels being 6.50 feet, the ground gone over by every turn of the wheels should be 20.07 feet; and we shall see, in fact, by the numbers shown on the wheel indicator, that the actual ground passed over differs very little from this number. The width of face of the driving wheels is 18 inches; they each form a veritable roller, bearing upon a great surface and preventing the destruction that might be found from the passage over them of so great a weight, of macadamized roads.

“These wheels work free upon the axle, and are only keyed to it by means of a strong pin of 2.36 inches diameter at the projecting end, which it is necessary to draw out a short distance to unlock the wheels when going around curves. This mode of connection, as simple as it is strong, is exceedingly convenient, and appeared entirely to answer the purpose intended. The two front wheels are only 3 feet 8 inches in diameter, and 12 inches wide on the face, but when the engine is on a level road they only carry 7-29ths of the total weight; those on the driving axle accounting thus for 22-29ths of this weight.

“The locomotive is, besides, provided with a fifth, steering wheel in front, or rather a thin disc of 2 1-2 feet diameter, which acts on the road by its own weight and by that of a triangular frame, fixed, by means of a horizontal joint, on the front part of the engine. The weight of all this apparatus is 6 cwt. 1 qr. 16 lb. only. This fifth wheel cannot exercise any injurious action upon the ground; but slight as the friction is, it is sufficient for moving the fore carriage which carries it, guided by the hand of the steerer, and by a very slight effort, in any required direction. The entirely effectual arrangement of the steering wheel is not one of the least interesting features of the engine in question.”

After giving a long and technical description of the Locomotive Boiler, and the large amount of heating surface provided,—which in a 14 H. P. engine reaches 273 1-4 square feet,—the report proceeds to detail the particulars of the load drawn:—

“In order to form a load, six wagons were filled with coal, the total weight of which added to the weight of the wagons, was 59 tons 14 cwt. 3 qr. The trial consisted of drawing this load from Beaurain to Senlis, and then from Senlis to Beaurain, a distance of 7.45 miles, presenting inclines and descents which in some instances were as great as 1 in 30. On the departure of the train the following conditions of the engine were noted:—

Fuel on the locomotive, 5 cwt. (560 lbs.)

Water in tenders, 375.47 gallons.

Level of the water in boiler below brass case of glass tube, 0.39 inches.

Steam pressure on starting, 97 lbs. per square inch."

Time occupied in the run from Beaurain to Senlis (7.45 miles,) 3h. 3m.

CONDITIONS ASCERTAINED ON ARRIVAL:

Fuel remaining on the engine, = 1c. 1q. 16lb. (156 lbs.)

Ashes and Cinders . . . = 1c. 0q. 14lb. (126 lbs.)

Water in the Tender after having refilled the boiler to the level of starting, 125 galls. which gives a consumption of 278.78 galls.

Pressure on arriving 90 lbs. per square inch," corresponding to 7-12 atmospheres, (French measure.)

"The facility with which this journey from Beaurain to Senlis, (7.45 miles) was accomplished, led us to suppose that the limit of traction power had not been sustained. It was believed that *two additional wagons* might still be attached, which Mr. Aveling had gone to fetch with the locomotive from the sugar factory at Beaurain. He set out at 3.25 P. M. and returned at 4.15 P. M. with another load, which was yoked on to the principal train.

"In consequence of this addition the total weight of the load drawn was raised to 79 tons 19 cwt. 1 qr. The adherent weight consisting of only 22-29ths that of the locomotive, we may call the total load equal to 7.65 times the adherent weight.

"In spite of these unfavorable conditions *the engine started very well and hauled the load on level ground and up slight inclines 1 in 250.*

"The care with which we registered the time of passing each kilometer post may appear excessive, but our motive was to ascertain convincingly if the engine, loaded as it was, had not slipped over any portion of the road. The total distance was 7.44 miles, and the counter marked 2.037 revolutions, which brings it to 19.29 feet of displacement per revolution. The figure is so near the exact figure, 6.12 miles, that *it may be considered no abnormal slip took place*, the slight observed difference not being greater than 4 per cent. of the external circumference of the wheel.

"To sum up: The engine La Ville de Senlis drew in a regular manner, upon a good road slightly undulating, a total load of 59 tons. The co-efficient of traction may be approximately estimated at 1-40, which would bring the mean strain to nearly 39 1-2 cwt., taking into account the weight of the locomotive."

"This mean effort, developed at a speed of 3.54 feet per second, brings the valuation of effective work to 15,623 foot-pounds per second,

or to 27.61 horse-power. This figure will appear high if it be compared with the consumption of fuel, which was 3c. 2q. 13 lbs. (405 lbs.) in three hours and three minutes, say, 132.15 lbs., per hour of actual travelling. This consumption represents only 4.40 lbs. of coal per horse-power and per hour.

“The corresponding consumption of water is not less than 132.22 gallons per hour of actual travelling. With the present tenders, which can hold 396 gallons of water, it is necessary to replenish them every 6 1-2 to 7 1-2 miles. The co-efficient of adherence may be estimated on the road gone over at 0.3 of the adherent weight. The adherence resulting therefrom was only necessary for the working of the engine up inclines of 0.030 (1 in 33 to 1 in 30) and at starting.

“The load of 79 19-20ths tons which the engine drew on level ground is not the limit of what it can draw under these conditions.

“A speed of 2.48 miles per hour appears suitable for traffic of this nature, and renders the manœuvres so easy that the train is well managed by a superintendent, an engine driver, and an assistant solely employed to guide the steering wheel in front.

“Done by the Engineer Sub-Director of the Conservatoire Imperial des Arts-et-Métiers.

H. TRESCA.

“Approved—The Director,

GENERAL MORIN.

“PARIS, 15th January, 1868.”

NOTE.—M. Tresca adds to his report some facts as to this engine, furnished by Messrs. Lallouette & Co.

From these it appears that it had only been worked half of the previous season, but during that time “it had conveyed 2,460 1-2 tons of beet-root from the weighbridge to the factory; a distance of 2.48 miles. It drew each journey 3 wagons loaded with 24t. 12cwt. 0q. 11lbs. of beet root, and the engine made 4 journeys and back; thus effecting the transport of 98 1-2 tons per diem.

The expenditure of fuel was not more than 9c. 3q. 10lbs. (1,102 lbs.) of coal for the 8 journeys,* and the trains were well managed by a driver and two assistants.

* Equal to 2 1-2 lbs. per ton. The ton referred to is 2,240 lbs.

IV.

VENTILATION OF THE FERRY BOATS.

Extract from a letter from L. W. Leeds, Engineer of Ventilation and Heating:

Mr. Leeds was consulted as to whether by any simple expedient, the sickening air often found in the saloons of the Staten Island ferry boats, when crowded and artificially heated, could be avoided without introducing draughts of cold air.

In reply he remarks:

"I think the uncomfortable feelings experienced in the upper saloon are much owing to the way in which it is warmed. The thin floor is exposed to the current of cold air sweeping through the carriage way below, and to keep up a tolerable average of heat, the upper part of the cabin must be highly heated, making the head hot and feet cold. To remedy this, I should think, it would be necessary to ceil below the floor, and that being done, it would be very desirable to pass a current of heated air beneath it, [in the interspace]; there appears to be an abundance for that purpose that now escapes around the smoke-pipe, and which might be utilized in that way.

There is also abundant power to create any amount of draught of heated air through the saloon, even when densely crowded, that may be desirable. But I do not believe that this alone would satisfy most persons, they need fresh, moderately cool air for breathing, and warmth to be supplied in a great measure by radiation or by contact with a warmed floor."

V.

AGRICULTURAL EFFECTS OF THOROUGH-DRAINAGE.

The large Gold Medal of the Highland and Agricultural Society of Scotland was last fall awarded to William W. Hozier, a farmer of Tannochside, for a paper entitled "Practical Remarks on Agricultural Drainage." At the conclusion of the paper, the author, after proving the greatly enlarged yield which has followed thorough-drainage, says:

"Nor is increased productiveness the only benefit therefrom accruing. By thorough-draining all the operations of agriculture are rendered less dependent on the variations of the weather; and farming, instead of being a hazardous game of chance, approaches to a certainty as nearly as any out-door occupation can be held to do in an unsettled climate. Drained land can be earlier ploughed in spring and, becoming sooner

workable after rainy weather, the seed is sown betimes, and the crops arriving earlier at maturity, harvest is expedited and the crop saved before the advent of bad weather. Stock can be sooner placed in pastures in the spring, and left out later in the autumn, thereby securing the advantages of a prolonged season. * * * * Owing to [the] increase of temperature [in the soil], germination is speedier, growth more rapid, and the quality of the crops enhanced. Drained land even acquires the power of producing crops which cannot possibly thrive on undrained land. The growth of wheat has thus been rendered certain, where formerly it was precarious. * * * * It counteracts the evil influence of drought in summer, * * while in winter the openness of the pores, which it induces, permits the frost to penetrate deeper and to pulverize the soil more thoroughly. Everywhere its introduction tends to the farmer's benefit by lessening the expense of seed and labor, and by adding to the fertility and consequent value of the land. The very climate is improved; dense and chilly fogs are dispelled. * * even diseases, such as rheumatism, ague and intermittent fevers, often disappear on its introduction. Cattle and sheep are more comfortable and, consequently, become healthier. In some Highland farms the diminution of casualties from 'braxy' has been found more than sufficient to cover the entire cost of draining."

The *Boston Journal*, of Chemistry, reports a trial made in this country in April, in which a difference in the temperature of the soil of the drained and the undrained part of a field, at four inches from the surface was found to be 13° , the condition in all other respects being as nearly as possible alike. Corn would germinate and grow on the drained and not on the undrained side of the field.

VI.

EFFECTS OF SATURATED SOIL ON BRUTES.

Prof. Liantard, of the New York College of Veterinary Surgeons, confirms, from personal observation, our statement that domestic animals, both of common and high bred stock, suffer much from malaria on Staten Island and other districts having highly saturated soils, about New York, and has kindly furnished the following letter:

To the Advisory Board of the Staten Island Improvement Commission:

GENTLEMEN: In reply to your inquiries, I beg leave to state that marshy and other malarious localities have always been regarded by

observing veterinary physicians as being injurious to domestic animals as well as men. I need not delay here to quote authorities upon this subject; they are abundant in the records of our profession.

Carbuncular fever, various putrid affections that tend to gangrenous termination, anæmia, hydræmia, catarrhal affections, periodic ophthalmias, grease, canker of the feet, etc., etc. Such are the diseases which, according to the seasons, affect animals inhabiting malarious localities. These very serious forms of disease show themselves during the summer months and in the autumn, when the marshy or other wet grounds are partially dried, and especially when the animals are turned out in the fields at evening, or during the night and morning—the periods when the air is loaded with vapor, and when the malarial elements are present in their highest proportion, and are saturated in the dews.

The growth of vegetation in marshy and malarial grounds is generally very active; the plants in such localities are usually large and watery, but containing little of nutritive elements. Animals fed with such herbage generally have very large and tumid bellies, their skin is thick, hard, and covered with long, rough hair (rough coated), the feet are flat and spreading, and the hoof material thin and brittle. Their blood contains an unhealthy proportion of watery elements; the lymphatic glands are excessively developed and swollen. Such animals may be larger framed, but they will be anæmic and feeble. Such animals—chronically poisoned by malaria—are thus already constitutionally and structurally predisposed to blood diseases, as also to diseases of the lymphatic and circulatory systems. Horses are thus predisposed to, and readily suffer from “distemper,” influenza, periodic ophthalmia, canker, glanders and farcy. Horned cattle, particularly in the spring, are often, from such poisoning, found suffering from anæmia, hydræmia, and parasitic diseases; and when thus associated with malarial empoisonments, such maladies generally appear under the entozoötic or epizoötic forms.

In regard to the question, “How is the malarial poison received into the system by domestic animals?” we find that the skin, being protected as it is by the rough, long coat of hair and by the thick epidermis, is less liable than in human beings to absorb malaria. But the digestive apparatus offers a more ready way for receiving the poison. Animals, in drinking the water of marshy or other malarial grounds, eating the herbage during the night—especially in morning hours—of plants covered with saturated dew, introduce into their digestive cavities the pathogenic malarial element, which is soon absorbed and made operative for evil in the blood. The pulmonary mucous membrane is likewise an open door for the introduction of paludal

malaria, and, as we know, that delicate membrane has a great power of absorption, both for liquid and gaseous elements. M. Roche, in a treatise published in 1852, states that "an adult horse, breathing at an average of 10 or 12 times per minute, would, in 24 hours, introduce into his organism, by respiration alone, from 6 to 7 *litres* of malarial elements."

I have the honor to be,

Gentlemen,

Respectfully yours,

ALEXANDRE F. LIAUTARD, M. D., V. S.

VII.

SANITARY GEOLOGY.

NOTE FROM PROFESSOR NEWBERRY UPON THE GEOLOGY OF STATEN ISLAND IN RELATION TO WATER-SUPPLY AND SANITARY DRAINAGE.

The following note from Professor Newberry sustains the view presented in the Report, of the drainage, even in the most difficult situations upon the island, and of the absorptive and reservoir character of the great central ridge of loose serpentine rock:

SCHOOL OF MINES OF COLUMBIA COLLEGE, }
NEW YORK, January 10th, 1871. }

F. L. Olmsted, Esq., Chairman Advisory Board, Staten Island Improvement Commission:

DEAR SIR:—In reply to your inquiry I would say that one result of my hasty reconnoissance of Staten Island was to convince me that geological causes exert an important influence on its salubrity. The geological conditions are important, mainly as they affect the drainage and water supply; and they are—very briefly stated—1st. a peculiar topography, apparently the result of glacial drift action, in which an unusual number of small, detached water-basins or pond-holes are a conspicuous feature; 2d. A hard-pan subsoil, more than usually retentive of moisture; 3d. The nature and relations of the different belts of rock which traverse the Island. These rocks are serpentine, sandstone, and trap rocks, which differ greatly in their power of absorption

and retention of water, and their conductibility of heat. How much they differ in these respects can only be determined by experiments not in progress, for your Board; but we know that they differ in a material degree. The serpentine is granular and porous in texture, and generally loose and open in structure, so that it promptly absorbs surface-water, and promotes natural drainage; while at the same time it is the great reservoir from which a water-supply must come. The sandstone has much the same physical characters, and whatever influence it exerts is similar to that of the serpentine, but it nowhere shows itself at the surface, and I only infer that it is present from what I know of the geology of the neighboring country. The trap is a very close and impervious rock, and is a ready conductor of heat. It is therefore an undesirable element in the geology of the Island. The belt it occupies is however, very narrow, and cuts only one side of the Island the ridge it forms is also very low, and while it is the rim of certain water-basins which must be drained to be salubrious, such basins are relatively small, and I was led to believe, by what I saw of them by no means beyond the reach of reclamation. The cretaceous clay, which underlie so much of the western part of the Island, are nearly impervious to water, and hence when underlying regular slopes must form a salubrious substratum. When scooped out into basins they like the trap rock, will retain water with great tenacity.

On the whole the effect of my visit was to give me a more hopeful view than I had before entertained of the sanitary problem before you. As it seems to me, thorough-drainage would remove nearly all the causes of insalubrity of the Island. To be effectual this drainage must be intelligently planned, and thoroughly carried out. It will cost money, but by bringing into market so much beautiful country, so near New York, I should say that it would many times repay its cost.

Yours, very truly,

J. S. NEWBERRY.

VIII.

RESULTS OF EXPERIMENTS ON THE ABSORPTIVE CAPACITY OF STATEN ISLAND SERPENTINE. BY PROFESSOR J. S. NEWBERRY.

SCHOOL OF MINES, COLUMBIA COLLEGE, New York, Jan. 27th, 1871.

Specimen No. 1. Compact Variety :

“ No. 2. Granular, porous variety from near surface.

	Loss in weight, per cent.	
	No. 1.	No. 2.
Air-dried by remaining two weeks in Columbia College cabinet, then		
Dried in air bath at 212° Fahr. 5 hours.....	1.13	2.90
	Gain in weight, per cent.	
	No. 1.	No. 2.
Saturated with water, then allowed to drain till surface was dry.....	12.84	28.41

For comparison I give below results of similar experiments on two well known varieties of sandstone.

No. 1, Amherst, Ohio ; No. 2, Bass Island, Lake Superior, artificially dried and then saturated with water.

	Weight,—per cent.
No. 1 absorbed.....	6.268
No. 2 “	6.718

From these experiments it will be seen

1st. That when exposed in dry air this Serpentine spontaneously parts with nearly all its moisture.

2d. That its capacity for absorbing moisture is remarkable, almost equal indeed to that of Carbonate of Magnesia ; the most compact variety absorbing *twice*, and the most porous *four times* as much water as average sandstones, generally regarded as the most porous of all our rocks.

The absorptive power of an average Limestone,—that of Athens, Ill.,—is 1.901 per cent. of its weight. Of Milwaukee Brick 17.118 per cent of its weight.

The gain on saturation, of these specimens of serpentine rock, would be nearly double their volume.

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